Ad Hoc Committee on Amateur Radio Digital Communication
Newington, CT
May 23-24, 1987

MINUTES

1. In Attendance

Members

Paul L. Rinaldo, W4RI (Chairman)
Thomas W. Comstock, N5TC (Board Liaison)
Lyle Johnson, WA7GXD
Phil Karn, KA9Q
Doug Lockhart, VE7APU
Eric Scace, K3NA

Observers

Phil Anderson, WØXI
Gordon Beattie, N2DSY
Jon Bloom, KE3Z
Mike Cheppomis, K3MC
Mike Huslich
Brian Lloyd, WB6RQN
Bob McGwier, N4HY
Norm Sternberg, W2JUP
Chris Sullivan, VE3NRT
David Toth, VE3GYQ

2. Study of Packet-Radio Frequencies

a. The committee reviewed the interim packet frequency recommendations in the minutes of its June 14-15, 1986 meeting. It reaffirmed most of its earlier recommendations, revised some of them, and added new particulars.

b. In that there was some uncertainty concerning MF and HF recommendations, the committee agreed that the chairman would review the specific frequencies with Executive Vice President Sumner prior to finalization. This review was needed to ensure that the frequencies were in keeping with both ARRL and IARU realities.

c. The committee's report was sent via MCI Mail to Director Quiat as Chairman, Membership Services Committee for review and submission of final packet-radio frequency recommendations to the Board of Directors in July, 1987. A copy of the report is attached to these minutes. Below are some of the discussion points not apparent in the attachment.

d. Frequency References: It was agreed that channel frequency would be specified as the center of the signal rather than suppressed-carrier (transceiver display), mark or space frequency, which vary considerably.

e. MF/HF:

(1) Eric Scace presented a discussion of 20-meter channel selection with respect to modem bandwidth. He pointed out that the NCDXF beacons at 14100 kHz need to be protected. Norm Sternberg said that the existence of these beacons is not universally known, and packet operators should be reminded to protect the beacons. After some discussion, it was agreed that 2-kHz channel spacing should be adopted. This was based on the feasibility of using generalized minimum-shift keying (GMSK) at 1200 bit/s, which theoretically can be filtered to occupy less than 1.4 kHz at the -26 dB points. The 20-meter frequency recommendations were based on the above analysis.

(2) The committee and observers were mindful of the impact of packet radio on foreign phone operation in the 14100.5-14150 kHz band, and recognized that it would be prudent to keep packet message forwarding operations below 14110 kHz. Two kHz spacing would allow for four channels in the 14100.5-14110 kHz range and provide adequate protection to NCDXF beacons. Doug Lockhart wished to be recorded as opposing 14100.5-14110 kHz because of interference to Canadian phone stations, and suggested that packet frequencies be located below the RTTY subband, ie, at the top of the CW subband. There was general agreement that while the RTTY subband has proven unworkable for packet message forwarding, it nevertheless should be used for general packet QSOs.

(3) The 40-meter band was also discussed in detail, particularly whether to operate packet in the US RTTY subband just below 7100 kHz or in the foreign RTTY subband around 7040 kHz. Both Eric Scace and Doug Lockhart strongly favored moving packet from the 7090-7100 kHz range to the 7030-7040 kHz range (the foreign RTTY subband). The (center) frequency 7091.3 kHz has been used for message forwarding in the US with moderate success. However, the packet message-forwarding net is now a North American net, and Canadian stations are not authorized to operate packet in either the 14100-14350 kHz or 7050-7100 kHz subbands without special DOC waivers.

(4) At this point in the meeting, it became clear that it was desirable that Executive Vice President Sumner be asked to review the specific frequencies discussed by the committee. (This was done subsequent to the meeting, and the report submitted to the Membership Services Committee reflect the results of this review.)

f. 6-meter Packet Frequencies:

(1) The committee reviewed frequency recommendations from SCRRBA and K2MF. Neither was adopted because the SCRRBA plan was based on nonstandard duplex offsets of 600 kHz (1 MHz is standard in the ARRL band plan), and the K2MF plan used frequencies in the radio-control section of the band.

(2) The committee's earlier 6-meter frequency recommendations were reaffirmed with the addition of Gordon Beattie's suggestion that high-in, low-out frequency usage apply where the duplex pairs are to be used for digipeaters that are co-sited with voice repeaters.

g. 2-meter Packet Frequencies:

After some discussion of expanding the 145.01-145.09 MHz suite, the committee agreed to leave its previous 2-meter frequency recommendations unchanged.

h. 1.25-meter Packet Frequencies:

The committee agreed to recommend 100-kHz bandwidth channels from 220.55 through 220.95 MHz and some 20-kHz channels both below and inside the Novice subband.

i. 70- through 23-cm Packet Frequencies:

The committee's recommendations are detailed in the report sent to the Membership Services Committee.

3. HF Autoforwarding STA

a. Paul Rinaldo reported the agreed-upon parameters for the STA of:

- one frequency per band
- 1200-baud operation deleted from this STA request
- duration is to be 6 months
- number of stations to be determined by letters of participation received as of cut-off date (May 26 postmark)
- specific frequencies to be those listed in the committee's report to the Membership Services Committee (plus or minus QRM)

b. David Toth asked for the time frame for changing BBS frequencies. It was agreed that frequencies would change with the effective date of the STA. Paul Rinaldo said that a notification of the STA activity and frequencies should be included in August **QST**.

c. Paul Rinaldo felt that the 1200-baud STA should be timed according to modem availability. Phil Anderson asked how many stations would be involved. Paul's reply was that we need a variety of path lengths, frequencies and propagation conditions to get good data on multipath behaviour.

4. Message Protocols

a. Paul Rinaldo explained that the Board of Directors has requested a recommendation by its January 1988 meeting on a new message format.

b. Eric Scace recommended that all person-to-person (as opposed to machine-to-machine) traffic must be handled by all modes (eg, packet, CW, or phone).

c. The committee agreed that the message format needs to separate preamble (which is transmission-mode dependent) from the part of the message that the addressee sees (and which is not mode-dependent). By necessity, the format of the preamble will vary according to mode. A parsable separator is needed.

d. Doug Lockhart noted that ASCII-to-Morse conversions need to be defined and standardized so that (a) it may be known what character set can be used for all modes, and (b) so that automatic translation from ASCII to Morse is possible.

e. The chairman appointed the following working group to study message protocols and report back to the committee:

Paul Rinaldo (convenor)
Eric Scace
Gordon Beattie (invitee)

5. Network and Transport Protocols

a. The committee reaffirmed its desire for continued experimentation in networking and transport protocols.

b. TCP/IP:

(1) Phil Karn outlined considerable progress with coding, which is still evolving. He said that about 35 stations in the Washington, DC area have the code. Phil noted that plans call for addition of software that will make TCP/IP interoperable with NET/ROM. WA4DSY is using the TCP/IP program to test his 56-kbit/s modem design. The program is available via ARPANET, Bdale Garbee's BBS and on disk. Brian Lloyd is handling disk dissemination of the code, which now includes Denmark, France, Germany, Japan, Switzerland, and the United Kingdom. IP addresses are being coordinated by Wally Linstruth. Brian noted that the code has been ported to the TAPR NNC. He added that experimenters in his area have been sending digitized voice using linear predictive coding over TCP/IP connections.

(2) Brian reported that a meeting of the east coast TCP/IP operators is scheduled for June 13 for the purpose of organizing a network.

(3) Phil Anderson indicated a need for a layman's description of TCP/IP, as most packeteers and dealers are unable to answer even simple questions about it.

c. COSI:

There was no new information since the April 24 issue of Gateway concerning progress with the firmware for COSI (Connection-oriented Open Systems Interconnection), which conforms with CCITT Rec. X.25.

d. NET/ROM:

Up-to-date documentation was provided to the committee.

e. TexNet:

New user documentation was provided to the committee subsequent to the meeting.

6. Sixth Computer Networking Conference

Paul Rinaldo reported that Harold Price is in the process of making arrangements in Los Angeles. Committee members should encourage implementers of various networking and transport protocols to present papers.

7. AX.25 Link Layer Protocol

a. A number of people have reported problems with, or suggested changes to, version 2.0 of AX.25, namely:

- o SDL (state-description language) diagrams need to be added to the document. (Terry Fox is to complete them in the near future.)

- o Making the number of octets in each call sign in the address field extensible (rather than a fixed 6 octets so that reciprocal call signs can be accommodated. (This would be a major change and necessitate a new version 3.0. Terry is studying whether this can be best accomplished through use of one of the reserved bits in the SSID.)

- o State problems (incomplete state closure).

- o Suggested performance enhancements, such as: true-p persistence and round-trip timing; longer frames (Phil Karn); removal of the T2 timer (Mike Huslich); and several suggestions from G3VPF and the Southwest AX.25 Group, VE3LNY (P/F bit) and N7CL.

- o A standard for host-mode TNC applications (not really an AX.25 issue).

b. The chairman named the following working group to consider any changes:

Terry Fox (convenor)
Eric Scace
Brian Lloyd (invitee)
Bob McGwier (invitee)

8. AMSAT Phase 4 Satellite

Highlights of the Phase 4 engineering meeting in Boulder were presented. The original engineering study called for a 19.2-kbit/s transponder. It was pointed out that speeds in the T1 (1.544 Mbit/s) range would be needed. Eric Scace recommended that we concentrate on the international speed of 2.048 Mbit/s. A dialog within the packet community is needed to determine packet requirements for Phase 4. It was agreed that development of modem and TNC technologies for 2.048 Mbit/s should be started now for both terrestrial and space applications.

9. Modems

The committee listed known modems or development efforts:

1200 bit/s:	o HF MSK/V.22/V.23 (KE3Z/N4HY developing) o TAPR PSK modem o G3RUH PSK modem
2400 bit/s:	o Kantronics KPC-2400 and derivatives
4800 bit/s:	o HAPN FSK modem
9600/19200 bit/s:	o GLB 220-MHz RF modem o AEA 220-MHz RF modem o ARRL lab 220-MHz RF modem (in development) o Kantronics (in development) o K9NG FSK modem
56 kbit/s:	o WA4DSY modem (under development)

10. AMTOR

The committee studied the draft AMTOR standard received from Peter Martinez, and reviewed correspondence received from AF8C and JARL. After some discussion, the committee felt that adopting an AMTOR standard at this time would not produce any benefit greater than the cost. It was agreed that the committee recommend that the League petition the FCC to amend Part 97 of the rules to recognize new CCIR Rec 476-4 and 625.

11. HF Packet Protocol

The committee reviewed the need for an optimal HF packet protocol. A fine-grain characterization of the medium is needed prior to protocol design. Lyle Johnson stated that the testing techniques need to be defined ahead of time so that volunteers will be forthcoming. The chairman designated a working group to define test data requirements, consisting of the following:

Paul Rinaldo (convenor)
Lyle Johnson
Eric Scace
Phil Anderson (invitee)
Bob McGwier (invitee)

The working group should consider:

- definition of the problem
- definition of test data needs
- data collection
- data analysis

12. Radio-Modem Interface Standards

a. The committee studied Paul Newland's draft entitled <u>An Interface Specification for Interconnecting Single-Sideband Radios to Audio Modulators and Demodulators</u>, May 1, 1987. The committee agreed that such an interface definition was needed and wishes to thank Paul Newland for his initiative.

b. Eric Scace advised against use of RCA phono jacks and recommends a single connector (possibly modular telephone connectors) for all signals. Brian Lloyd suggested the need for a "clear to send" signal from the transmitter. Phil Karn suggested that standard signal levels be addressed first, with connector standards secondary.

c. Paul Rinaldo reported on the League's dialog with the Japan Amateur Radio Industry Association (JAIA) concerning connector standards and recommended that this matter be raised with the JAIA Technical Committee. Brian Lloyd volunteered to come up with a one-page paper reflecting the results of the committee's discussion.

Respectfully submitted,

Paul L. Rinaldo, W4RI
Chairman

Annex A. to Doc. #

PACKET RADIO FREQUENCY RECOMMENDATIONS OF THE AD HOC COMMITTEE ON AMATEUR RADIO DIGITAL COMMUNICATION

These recommendations are in response to Board Minutes 45(a) (study designation of packet-radio traffic channels) and 45(h) (study recommended operating frequencies for VHF packet and HF packet radio) of the 1986 Annual Meeting and Minute 80 of the 1987 Annual Meeting.

1. General

According to Part 97 of the FCC rules, packet radio may be operated on any frequency where digital communications is permitted.

2. Frequency References

A. The primary references to packet-radio frequencies should be by center frequencies.

B. Display frequencies (what appears on the transceiver frequency readout) are not uniform and should be used only for secondary reference when transceiver settings and modem center frequencies are known. Mark and space frequencies vary according to the modem in use.

3. 80-20 Meter Bands

A. General:

(1) The packet-frequency selection objective is to minimize impact on existing operations, recognizing that the spectrum in these HF bands is a limited resource.

(2) Using the spectrally conservative mode of minimum-shift keying (MSK), 1200-baud operation should be possible within a 2-kHz bandwidth. Thus, a 2-kHz raster is recommended for packet frequencies in these bands.

B. The use of the RTTY subbands is encouraged for packet operations in these bands. The frequencies listed below are exceptions to this general rule to provide usable channels for automatic message forwarding:

(1) 80 Meters (kHz)

3594.3	Intercontinental message forwarding
3607.3	North American message forwarding

(2) 40 Meters (kHz)

7038.3	Intercontinental message forwarding
7091.3	North American message forwarding

(3) 30 Meters (kHz)

10145.3	Intercontinental message forwarding
10147.3	North American message forwarding

Note: These frequencies are subject to noninterference with fixed stations outside the United States.

(4) 20 Meters (kHz)

14102.3	Intercontinental message forwarding
14108.3	Intracontinental message forwarding

Note: The lowest frequency provides sufficient protection to receivers using CW bandwidths to receive 14100-kHz beacons.

4. 160- and 17-10 Meters

The frequencies listed below conform to the RTTY subbands and are suggested for automatic message forwarding when propagation is favorable.

A. 160 Meters (kHz)

1802.3

B. 17 Meters Pending FCC Allocation (kHz)

18106.3
18108.3

C. 15 Meters (kHz)

21096.3
21098.3

D. 12 Meters (kHz)

24926.3
24928.3

E. 10 Meters (kHz)

28102.3
28104.3

Note: These 28-MHz frequencies may be considered for both automatic message forwarding and network entry points for Novices and Technicians.

5. <u>VHF/UHF Frequencies</u> (MHz)

A. Specific VHF/UHF channels recommended below may not be available in all areas of the US.

(1) Prior to regular packet-radio use of any VHF/UHF, it is advisable to check with the local frequency coordinator.

(2) The decision as to how the available channels are to be used should be based on coordination between local packet-radio users.

B. <u>6 Meters</u>

(1) National packet simplex frequency: 51.70

(2) Duplex pairs to consider for local coordination for uses such as repeaters and meteor scatter:

50.62 - 51.62
50.64 - 51.64
50.66 - 51.66
50.68 - 51.68
50.72 - 51.72
50.74 - 51.74
50.76 - 51.76
50.78 - 51.78

Note: Where duplex packet-radio stations are to be co-sited with voice repeaters, use high-in, low-out to provide maximum frequency separation from low-in, high-out voice repeaters.

C. <u>2 Meters</u>

(1) Automatic/unattended operations should be conducted on 145.01, 145.03, 145.05, 145.07 and 145.09 MHz.

(a) 145.01 should be reserved for inter-LAN use.

(b) Use of the remaining frequencies (above) should be determined by local user groups.

(2) Additional frequencies within the 2-meter band may be designated for packet-radio use by local coordinators.

D. <u>1.25 Meters</u>

(1) 100-kHz-bandwidth channels:

220.55
220.65
220.75
220.85
220.95

(2) 20-kHz-bandwidth channels:

221.01
221.03
221.05
221.07
221.09

223.40 National packet simplex calling

223.42 Candidate packet simplex channels
223.44 shared with FM voice simplex. Check
223.46 with your local frequency coordinator
223.48 prior to use.

E. <u>70 Centimeters</u>

(1) The 70-cm band plan needs to be revamped because of the reallocation of the 420-430 MHz band above Line A and having to take a secondary status to land mobile usage in Buffalo, Detroit and Cleveland. Furthermore, it has no place for data communications without some contention with other modes.

(2) 100-kHz-bandwidth channels:

430.55
430.65
430.85
430.95

(3) 25-kHz-bandwidth channels:

440.975
441.000 Message forwarding
441.025
441.050
441.075

(4) Cross-border packet with Canada should be conducted within the 433-434 MHz band as the DOC has allocated this band for packet transmissions not exceeding 100 kHz in bandwidth.

F. <u>33 Centimeters</u>

Requires further study before nominating specific packet frequencies. The interim band plan adopted at the October 1984 Board Meeting should be reviewed in light of importation of Japanese Personal Radio Service equipment. The PRS transceivers are about all there is likely to be for some time, except for transverters. Use of the PRS radio equipment would help populate the band. The study question is: If it is desirable to encourage importation of PRS radios, does this signal a need to reconsider the band plan?

G. <u>23 Centimeters</u>

(1) 2-MHz channels:

1249, 1251, 1298 MHz

(2) 100-kHz channels:

1299.05
1299.15
1299.25
1299.35
1299.45
1299.55
1299.65
1299.75
1299.85
1299.95

(3) 25-kHz channels:

1294.025
1294.050
1294.075
1294.100 National packet calling
1294.125
1294.150
1294.175

6. <u>Higher Bands</u>

Requires further study.

Respectfully submitted,

Paul L. Rinaldo, W4RI
Chairman

To: N2DSY
Fr: K2MF @ N2DSY /03100201
Dt: 870522/2237z
Sb: VUAC REPORT

AMERICAN RADIO RELAY LEAGUE, INC.
VHF/UHF ADVISORY COMMITTEE

MEMORANDUM

Date: March 30, 1987

To: Jay Holladay, W6EJJ, ARRL First Vice President
From: Barry Siegfried, K2MF, VUAC Hudson Division
Copy: H. Paul Schuch, N6TX, VUAC Chairman
Lisa Arel, ARRL Headquarters
Stephen Mendelsohn, WA2DHF, Hudson Division Director

Subject: VUAC Packet Frequency Recommendations

I have been tasked by Mr. Schuch to offer the report of the VUAC to the Packet Radio Task Force of the ARRL Executive Committee. It is my hope that this report will arrive in time for the Task Force's meeting in Visalia, CA.

Overview

It would appear that, in the Amateur Radio community, the bodies responsible for frequency coordination originally adopted a "hands off" policy with respect to packet radio, since this mode was initially viewed as a simplex-only mode. However, with the advent of full-time single- and dual-port Digipeaters and Message Servers (Bulletin Boards and Remote Access Systems), this point of view is rapidly beginning to change. An example of this is, that as of this writing, the Tri-State Amateur Repeater Council (TSARC), which is the frequency coordination body responsible for the metropolitan area in and around NYC, has already appointed a Packet Frequency Coordinator who functions under a Packet Radio Subcommittee of the Council, and is involving itself more and more with packet radio in general. No doubt there are other frequency coordinating bodies appointing similar individuals to address the growing demand for packet radio frequencies in other parts of the USA. It is clear that the subject of packet frequency coordination is fast becoming an important concern for the future.

With respect to the digital transmission modes, I have attempted below to summarize the inputs of various Members of the VUAC, Frequency Coordinating Councils, Regional Frequency Band Specialty Clubs and Digital/Packet Radio Organizations into a coherent report of packet frequency recommendations. It is not to be assumed that this report is by any means the result of an exhaustive polling of opinions, but rather it is a compilation of materials that this writer has thus far had the opportunity to study. Frequencies which have been recommended by more than one source are highlighted in the report below.

6 Meters

Recommendation by:
New York State Packet Federation (NYSPF)
Radio Amateur Telecommunications Society (RATS)
Six Meter International Radio Klub (SMIRK)

50.60 - 50.80 1200 bps Packet Operation (+/- 5 KHz.)/RTTY

50.61, 50.63, 50.65, 50.67, 50.69 (10 Channels)
50.71, 50.73, 50.75, 50.77, 50.79

Recommendation by:
Southern California Six Meter Club (SCSMC)

50.80 - 51.00 1200 bps Packet Operation (+/- 5 KHz.)/RTTY

50.81, 50.83, 50.85, 50.87, 50.89 (10 Chonnels)
50.91, 50.93, 50.95, 50.97, 50.99

Recommendation by:
Radio Amateur Telecommunications Society (RATS)

~~51.15~~ 51.250 ~~9600~~ 72Kbps bps Packet Operation (+/- [illegible] KHz.) - Special
~~51.95~~ 51.850 Temporary Authorization required for wideband usage
(2 Channels)

Recommendation by:
New York State Packet Federation (NYSPF)

51.90 - 52.00 1200 bps Packet Operation (+/- 5 KHz.)

51.91, 51.93, 51.95, 51.97, 51.99 (5 Channels)

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2 Meters

Recommendation by:
ARRL VHF/UHF Advisory Committee (VUAC)
Michigan Area Repeater Council (MARC)
Mid Atlantic Packet Radio Council (MAPRC)
Middle Atlantic Repeater And FM Council (T-MARC)
New York State Packet Federation (NYSPF)
Packet Of Long Island (POLI)
Packet Of New York (PONY)
Radio Amateur Telecommunications Society (RATS)
Tri-State Amateur Repeater Council (TSARC)

144.90 - 145.00 1200 bps Packet Operation (+/- 5 KHz.)/RTTY

144.91, 144.93, 144.95, 144.97 144.99 (5 Channels)

Recommendation by:

ARRL VHF/UHF Advisory Committee	(VUAC)
Michigan Area Repeater Council	(MARC)
Mid-Atlantic Packet Radio Council	(MAPRC)
Middle Atlantic Repeater And FM Council	(T-MARC)
New York State Packet Federation	(NYSPF)
Packet Of Long Island	(POLI)
Packet Of New York	(PONY)
Radio Amateur Telecommunications Society	(RATS)
Rocky Mountain Packet Association	(RMPA)
Tri-State Amateur Repeater Council	(TSARC)

145.00 - 145.10   1200 bps Packet Operation (+/- 5 KHz.)

145.01, 145.03, 145.05, 145.07, 145.09

Tentative recommendation for additional packet use in high-traffic areas or in dual-frequency systems by:
New York State Packet Federation (NYSPF)

145.50 - 145.60   1200 bps Packet Operation (+/- 5 KHz.)

145.51, 145.53, 14.55, 145.57, 145.59 (5 Channels)

A side note to the 2 meter packet frequency recommendations is that, particularly in the more densely populated areas, there is a growing concern that the 2-meter space between 144.90 and 145.10 will not be able to support the increasing level of packet radio activity much longer.

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135 Centimeters

Recommendation by:

Mid-Atlantic Packet Radio Council	(MAPRC)
Middle Atlantic Repeater And FM Council	(T-MARC)
New York State Packet Federation	(NYSPF)
Packet Of Long Isl}nd	(POLI)
Packet Of New York	(PONY)
Radio Amateur Telecommunications Society	(RATS)
Tri-State Amateur Repeater Council	(TSARC)

220.50 - 221.00   9600 bps Packet Operation (+/- 40 KHz.)

220.55, 220.65, 220.75, 220.85, 220.95 (5 Channels)

Recommendation by:
New York State Packet Federation (NYSPF)
Packet Of Long Island (POLI)
Packet Of New York (PONY)
Radio Amateur Telecommunications Society (RATS)
Tri-State Amateur Repeater Council (TSARC)

221.00 - 221.20 1200 bps Packet Operation (+/- 5 KHz.)

221.01, 221.03, 221.05, 221.07, 221.09 (10 Channels)
221.11, 221.13, 221.15, 221.17, 221.19

The VUAC urges that packet channels be allocated in the lower 220-222 MHz. portion of the 135 cm. band, and that they be populated as quickly as possible in an effort to retain that band segment from reallocation to the land mobile service.

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70 Centimeters

Recommendation by:
Middle Atlantic Repeater And FM Council (T-MARC)
New England Spectrum Management Council (NESMC)
Philadelphia Area Repeater Council (T-PARC)
Radio Amateur Telecommunications Society (RATS)
Tri-State Amateur Yepeater Council (TSARC)
Upper New York Repeater Council (UNYREPCO)

430.00 - 430.70 9600 bps Packet Operation (+/- 40 KHz.)

430.05, 430.15, 430.25, 430.35, 430.45, 430.55, 430.65 (7 Channels)

430.750 could not be assigned for the above purpose since it is paired as an aural ATV output with 426.250.

430.80 - 431.00 9600 bps Packet Operation (+/- 40 KHz.)

430.850, 430.950 (2 Channels)

431.01 1200 bps Packet Operation (+/- 5 KHz.) (1 Channel)
441.00 1200 bps Packet Operation (+/- 5 KHz.) (1 Channel)

Recommendation by:
Radio Amateur Telecommunications Society (RATS)

431.02 - 432.00 1200 bps Packet Operation +/- 5 KHz.)

431.03, 431.05, 431.07, 431.09 (4 Channels)

Tentative recommendation for additional packet use by:
New York State Packet Federation (NYSPF)

446.79 - 446.91 1200 bps Packet Operation (+/- 5 KHz.)

446.800, 446.825, 446.850, 446.875, 446.900 (5 Channels)

The above tentative recommendations are not currently supported by the TSARC UHF Frequency Coordinators because these channels fall within the repeater sub-band in the TSARC area.

The VUAC recommends that packet allocations be established in the 70 cm. band, with channel spacings sufficient to permit wider band emissions and higher bps rate experimentation.

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23 Centimeters

The VUAC urges that a packet allocation be established in that portion of the 23 cm. band recently allocated to Novice Class Amateurs, with the hope that this will attract new computer hobbyists into the ranks of Amateur Radio.

I hope that the above will be helpful to the Packet Radio Task Force in formulating its allocations for packet frequency usage.

Very 73,

Barry Siegfried, K2MF
VUAC, Hudson Division

Message 5:
From mike Mon Mar 30 22:23:27 1987
Date: Mon, 30 Mar 87 22:23:20 pst
From: mike (Mike Brock) (tty09)
Message-Id: <8703310623.AA07577@net1.UCSD.EDU>
To: wally
Subject: 6M packets
Cc: mike
Status: R

Wally, here is something that SCRRBA is putting together for you and Harold to present at the upcomming ARRL Digital committie meeting. When is that meeting anyway? If you have comments and/or suggestions now is the time to make them known (that is if we have time before the meeing). Again I expect that you and Harold take this to the committie so what ever happens make sure that you have a copy with you before leaving.

Mike

>From lbv@chem Fri Mar 27 17:33:32 1987
Date: Fri, 27 Mar 87 17:32:32 pst
From: lbv@chem (Gordon Schlesinger)
Message-Id: <8703280132.AA05204@sdchemg.chem.ucsd.arpa>
To: mike@net1
Subject: Here it is!
Status: R

Paul

For the committee's consideration

Wally

ALLOCATING SPECTRUM FOR PACKET RADIO ON 6 METERS

Current Practice and Recommendations for a National Policy

contributed by

The Southern California Repeater and Remote Base Association
(SCRRBA)

March 27, 1987

INTRODUCTION

Very early in the development of packet radio in southern California SCRRBA recognized the inherent communications advantages of the new mode and began to consider spectral allocations for it on each of the frequency bands which SCRRBA coordinates (10 meters, 6 meters, 70 centimeters and all higher frequency bands). Subsequently, at the time of establishment of new band utilization plans (for southern California), representatives of packet radio were invited to participate in the regional meetings through which the plans were created. In the case of bands for which local plans had already been established and were already being followed, separate meetings were held with representatives of the packet radio mode to ascertain their projected spectral needs and to make the adjustments necessary to accommodate packet radio. It was by the latter mechanism that establishment of specific channels for use by packet radio in southern California on 6 meters was accomplished.

RECOMMENDATION

SCRRBA has allocated 3 pairs of 20F3, (20 kHz voice bandwidth) channels for utilization by packet radio stations:

51.12	51.72
51.14	51.74
51.16	51.76

The channels may be used singly or as duplex pairs, without prior coordination by SCRRBA.

JUSTIFICATION AND EXPLANATION

The allocations at 51 MHz for packet radio communications in southern California were adopted by SCRRBA prior to the time at which the ARRL Digital Advisory Committee formulated its initial recommendation to place these emissions at the high end of 50 MHz. SCRRBA has considered the Committee proposal, and wishes to contribute the following items in support of a recommendation to establish a permanent packet allocation in the 51 MHz region.

1] The ARRL proposal (packet around 50.600 MHz and above) could create problems for users of other emissions modes. Locating packet at 50.600 MHz and above would place essentially _automatically controlled_ stations of moderate to high performance (10 - 200 watts ERP) proximate to the regions of highest activity, highest population density, and greatest individual station performance (i.e., weak signal dx) in the entire 6 meter band. Below the proposed allocation are the various weak signal dx modes, some of which stations use "wide open" high performance receiver front ends. Above it are the RC operators, who operate model aircraft containing fairly unselective receivers. Loss of effective radio control of these vehicles could create problems. In the middle of the allocation (at 50.700 MHz) is the RTTY spot frequency.

2] The SCRRBA allocation places the packet traffic between 51.000 and 52.000 MHz, into a region identified by the ARRL 6 meter plan only as "6 meter FM simplex". The only known activity in this MHz is within the bottom 100 kHz. This activity ("south Pacific dx window") probably no longer is current since Australia and New Zealand are/will be getting full 6 meter band privileges. Clearly in this segment no one will be bothered by potential "out of channel" emissions, and there is ample room for packet expansion.

3] Additionally, there is room within 51 MHz for establishment of an "offset" allocation of channels, permitting duplex or simultaneous half-duplex operations of co-sited stations. The ARRL proposal makes no provision for this sort of thing; only a single set of channels is proposed.

4] The allocated channels will be useful for packet experimentation with meteor scatter communications. They are sufficiently above the weak signal dx area so that packet communications will not prove troublesome to the dx work, yet sufficiently low in frequency to permit utilizing the available MUF and to avoid harmful interference from voice-bandwidth FM repeaters and television channel 2 transmitters.

5] Finally, joint SCRRBA-NARC (Northern Amateur Relay Council) approval for the proposed set of 51 MHz channels has already been reached. Since VHF relay activities are more numerous in California than in other states, the implication is that 51 MHz channel utilization over an entire region (for level 2 or level 3 trunking) may be easily achievable.

CONCLUSION

SCRRBA believes that, for the reasons cited above, there is considerable merit in locating packet radio channels between 51 and 52 MHz, in contrast to placing them in the congested 50 - 51 MHz region. We recommend that the ARRL Digital Advisory Committee carefully consider our proposal.

Respectfully submitted,

The Southern California Repeater
and
Remote Base Association

by

Gordon Schlesinger, WA6LBV
Secretary

RECEIVED
A.R.R.L. #5

1987 MAY 14 PM 1:01

513 Kenilworth Road
Bay Village, Ohio 44140

May 7, 1987

Paul L. Rinaldo, W4RI
Editor
The American Radio Relay League
225 Main Street
Newington, CT 06111

Dear Paul,

Included below is a review of the AMTOR documents per your letter of April 8, 1987, concerning incorporation of CCIR Rec. 625.

I am not yet a user of AMTOR equipment, since I dropped into packet radio in 1985 and have not had the time or funds available to justify getting into AMTOR. I have high interest, however, in eventually purchasing an all-purpose "TU" that could operate CW, Packet, RTTY, and AMTOR from my ASCII port on my computer.

I was interested to read in the documents that you supplied, the original CCIR wording of Rec. 476-4 (476-3 being the basis for the AMTOR amateurs use today and is outlined in the ARRL HANDBOOK), and of Rec. 625.

It must have been an understatement of yours about the "subtle changes" that 625 would add to AMTOR if implemented in close adherence to 625. I would say that several main differences exist that would imply that AMTOR equipment manufacturers could be adding much new microprocessor code to the AMTOR units to accomplish comformance to a new wording of 97.69 (b)(3), per the following remarks:

(1) 625 is much more rigorously defined and due to the added features of 625, AMTOR equipment would need either a hard or a "soft" means of switching from 476-x mode to 625 mode. Not all amateurs would or could purchase new AMTOR equipment, and the users would therefore want to select which mode to converse in.

(2) The modulation rate clock tolerance ("30 parts in 10\6/ or better") would probably add little cost to AMTOR equipment, in terms of today's technology in computer crystal oscillators.

(3) Today's better receivers would be able to support a tighter bandwidth tolerance, but not all amateurs purchase the latest technology. With poorer bandwidth filtering, additional loss in signal to noise ratio means a higher bit error rate would be suffered, but then 625 incorporates a tighter control of mutilated character handling (as I read it) and therefore AMTOR reception should not be highly impacted by NOT having a tighter bandwidth spec on our receivers in all cases. (Real AMTOR users would be in a better position to know if I am right in saying that.)

(4) There is, among all the other details of check-sum handling, ID verification, etc., the little detail (e.g. 625 3.5.4.) that 128 cycles are waited before re-sending a call signal. I found no such details in 476-4. I think when all the other changes are incorporated this is merely one more detail.

(5) Implementation of these features in AMTOR equipment would provide the following advantages:

(a) tighter error control, with possible emulation of packet radio AX.25 "connect" protocols, IF we figure out an amateur call sign version of the identity number translation and checksumming of 491-1 and 625. (I don't believe that I am stretching the limits of reality in stating this.)

(b) possible "broadcast" or "netting" communications that amateurs would like to use in amateur nets, similar to the Collective-B mode operation in 625, which would also be a form of being "connected" to a net, a feature we all don't really have in packet radio yet (stressing the word CONNECT, as opposed to CONVerse mode on my TNC-1.)

(c) features of 625 are not at the limits of technology, giving AMTOR users and experimenters the chance to further evolve AMTOR technology and advance the state of the art of radio communications in general. I see features of AMTOR that could yet give it an edge in competing with AX.25 in world-wide HF amateur communication links. I am all for amateur radio digital technology providing an invention or two for the rest of the world to use.

(6) Some small disadvantages of designing in 625:

(a) more features and specifications mean longer, more involved software/firmware routines, costing more to develop into AMTOR products, requiring more code space and therefore more ROM or PROM chip space (higher cost again), and perhaps use of 16 or 32 bit processors (more cost). With modern compiler technology, the coding job would not be too difficult. But adding development time usually means higher product cost to reimburse the development expenses, depending also on whether the development is done by an amateur organization such as TAPR, or by profit-making manufacturers.

(b) This would be another advance in the state-of-the-art that outpaces the funds available for some amateurs to keep up with the latest equipment for sale.

But we cannot let disadvantages stand in the way of technical advances that benefit the community. Historically, progress happens when the time is ripe, and can't be stopped.

My opinion is that 625 should be added to part 97.69 (b)(3) with due haste.

Sincerely, and 73

Glenn L. Williams

Glenn L. Williams, AF8C
ARRL Technical Advisor
Great Lakes Division

Date: Thu May 14, 1987 10:39 pm EDT
From: MCI Mail

TO: * American Radio Relay League / MCI ID: 215-5052
Subject: Telex Message

JAPRETAR J23868

ATTN: MR PAUL RINALDO
ARRL

SUBJECT: INQUIRY TO AMTOR

DEAR PAUL,
WE HAVE NO COMMENT TO ADD TO YOUR INFORMATION CONCERNIG
AMTOR. 73, FUJIO YAMASHITA JS1UKR, JARL
MAY 15TH,1987.

JAPRETAR J23868

MX·COM, INC.

MX419
MX519

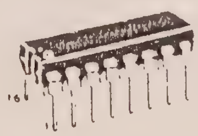
1200 BAUD MINIMUM SHIFT KEY MODEM

FEATURES:

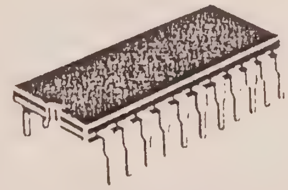
- Full Duplex 1200 Baud MSK
- On-Chip R_x/T_x Bandpass Filters
- R_x/T_x Synchronization Clocks
- Carrier Detect O/P
- Narrow Band Frequency Shift
- Few External Components Required
- Read/Write Sync Control
- Easy Microprocessor Interface

APPLICATIONS:

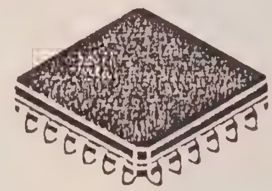
- Nordic Mobile Telephone 450/900 Cellular
- German ZVEI
- French Radiocomm 2000
- UK Band III
- Japanese Personal Radio trunked SMR systems



MX519J (CDIP)
MX519P (PDIP)
16 pins



MX419J (CDIP)
MX419P (PDIP)
22 pins



MX419LH
(24p PLCC)

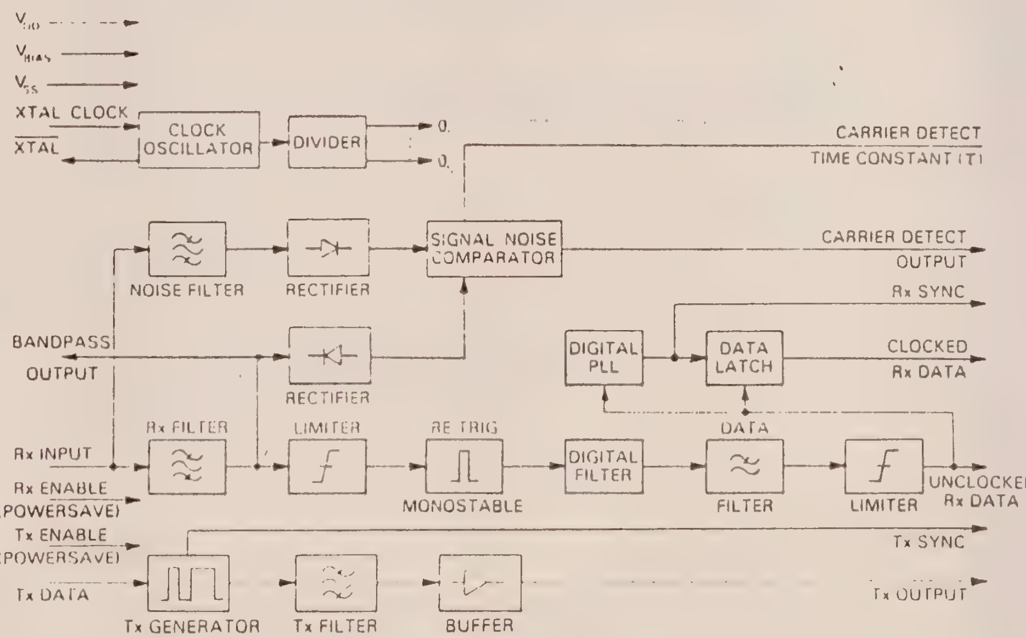


Fig. 1 Internal Block Diagram

DESCRIPTION:

The MX419/519 is a single chip CMOS LSI Modem employing Minimum Shift Key signaling at 1200 baud, compatible with the data transmission standards of numerous operating systems worldwide. In addition to the applications listed above, the American Association of Railroads uses 1200 baud MSK on board trains in a radio telemetry application that replaced the caboose.

MSK (also known as FFSK) operation at 1200 baud employs phase continuous 1200/1800 Hz mark and space frequencies in which data transitions occur only at the signal zero crossing point. This provides identical mark/space period timing and an occupied band of only 1200 Hz. The MX419/519 derives its carriers, switched capacitor filter clocks, and R_x and T_x synchronization from an external 1.008 MHz crystal. A carrier detect O/P is provided as well as a recovered R_x clock.

The MX419 succeeds the MX409 in a functionally equivalent package, while adding an output from the R_x bandpass filter. The MX519 employs the same die in a smaller, more economical 16 pin DIP package.

MX419/519 PIN FUNCTION TABLE

PIN			FUNCTION/DESCRIPTION
DIP MX419J,P	PLCC MX419LH	DIP MX519J,P	
1	1	16	**Xtal/Clock:** The input to an on-chip inverter for use with a 1.008MHz xtal. Alternatively, a 1.008MHz clock may be used.
2	2	1	**$\overline{\text{Xtal}}$:** Output of on-chip inverter.
3	3	2	**Tx Sync O/P:** A 1200Hz squarewave used to synchronize the input of logic data and transmission of the MSK signal *(See Fig. 5)*.
4	4		**No Connection:** Leave open circuit.
5	5	3	**Tx Signal O/P:** With transmitter disabled, this pin is set to a high impedance state. When transmitter is enabled, this pin outputs the 1200/1800Hz (140 step pseudo-sinewave) MSK signal *(See Fig. 5)*.
6	7	4	**Tx Data I/P:** Serial logic data to be transmitted, is input to this pin and synchronized by the "Tx Sync O/P" *(See Fig. 5)*.
7	8	5	**$\overline{\text{Tx Enable}}$:** A logic '1' applied to this input will put the transmitter into powersave while forcing "Tx Sync O/P" to logic '1' and "Tx Signal O/P" to a high impedance state. A logic '0' will enable the transmitter *(See Fig. 5)*. This pin is internally pulled to V_{DD}.
8	9		**Bandpass O/P:** This is the output of the Rx 900-2100Hz bandpass filter. The output impedance of this pin is typically 10kΩ and may require buffering prior to use.
9	10	6	**Rx Enable:** A logic '0' applied to this input will put the receiver into powersave while forcing "Clocked Data O/P" and "Carrier Detect" to logic '0.' A logic '1' will enable the receiver *(See Figures 2 and 6)*. "Rx Sync Out" may be logic '1' or '0' during powersave. This pin is internally pulled to V_{DD}.
10	11	7	**Bias:** Provides bias internally and should be decoupled externally to V_{SS} by a capacitor *(See Fig. 2)*.
11	12	8	**V_{SS}:** Negative supply.
12	13	9	**Unclocked Data O/P:** This pin outputs recovered asynchronous serial data from the receiver.
13	14	10	**Clocked Data O/P:** This pin outputs recovered synchronous serial data from the receiver and is internally latched out by a recovered clock appearing on the "Rx Sync O/P" pin *(See Figures 2 and 6)*.

MX419/519 PIN FUNCTION TABLE

PIN			FUNCTION/DESCRIPTION
DIP MX419J,P	PLCC MX419LH	DIP MX519J,P	
14	15	11	**Carrier Detect:** This pin will output a logic '1' when an MSK signal is being received.
15	16	12	**Rx Signal I/P:** This is the MSK signal input pin for the receiver and should be decoupled via a capacitor C_3.
16	17		**No Connection:** Leave open circuit.
17	18	13	**Rx Sync O/P:** This is a flywheel 1200Hz squarewave output which, upon presentation of MSK data signal, is synchronized internally to the incoming data *(See Figures 2 and 6).*
18,19	19,10,21		**No Connection:** Leave open circuit.
20	22	14	**Carrier Detect Time Constant (τ):** This input forms part of the carrier detect integration function. The value of C_4 connected to this pin will affect the carrier detect response time and hence noise performance *(See Fig. 2, Note 4).*
21	23		**No Connection:** Leave open circuit.
22	24	15	**V_{DD}:** Positive supply.

Note: Output Loading.

Large capacitive loads could cause the output pins of this device to oscillate. If capacitive loads in excess of 200pF are unavoidable, a resistor of typically <100Ω put in series with the load should minimize this effect.

MX419/519 ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Exceeding the maximum rating can result in device damage. Operation of the device outside the operating limits is not implied.

Supply voltage		−0.3V to 7.0V
Input voltage at any pin (ref V_{SS} = OV)		−0.3V to (V_{DD} + 0.3V)
Output sink/source current (total)		20mA
Operating temperature range:	MX419J/MX519J	−30°C to +85°C
	MX419P,LH/MX519P	−30°C to +70°C
Storage temperature range:	MX419J/MX519J	−55°C to +125°C
	MX419P,LH/MX519P	−40°C to +85°C
Maximum device dissipation:		All versions 100mW

Operating Limits

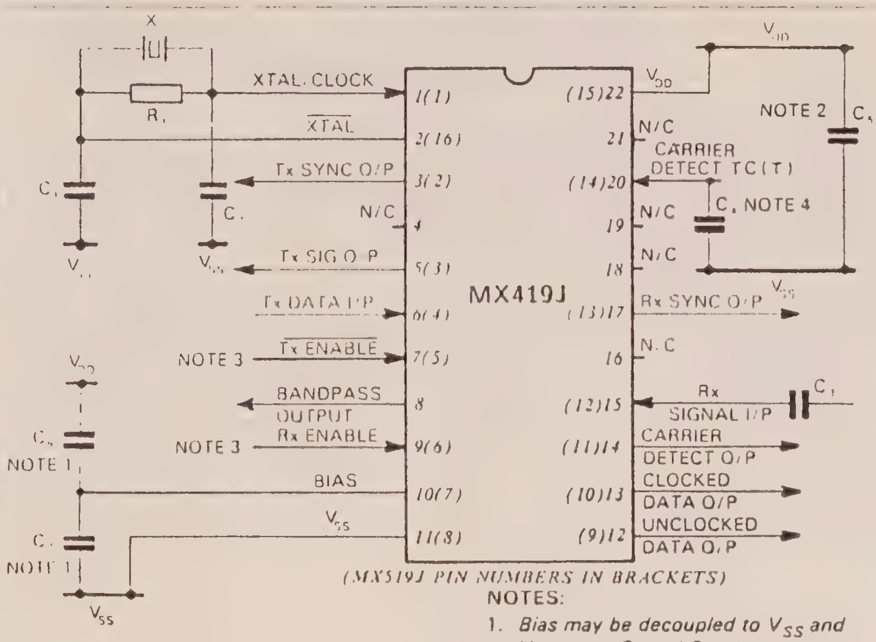
V_{DD} = +5V, T_{amb} = 25°C, ∅ = 1.008MHz (Xtal), $\Delta f∅$ = 0

All characteristics measured using the standard test circuit (figure 4) with the following test parameters which is valid for all tests unless otherwise stated:

0dB reference	300mV rms
Noise	(band limited 5kHz gaussian white noise)
SNR ratio measured in bit rate bandwidth (1200Hz)	

Characteristics	See Note	Min	Typ	Max	Unit
Static Characteristics					
Supply volts		4.5	5.0	5.5	V
Supply current: Rx (Enabled) Tx (Disabled)		—	3.6	—	mA
Rx (Enabled) Tx (Enabled)		—	4.5	—	mA
Rx (Disabled) Tx (Disabled)		—	650	—	μA
Logic '1' level		80%V_{DD}	—	—	V
Logic '0' level		—	—	20%V_{DD}	V
Digital O/P Impedance		—	4	—	kΩ
Analog and Digital input impedance		100	—	—	kΩ
Tx O/P impedance		—	10	—	kΩ
On-chip crystal oscillator:					
R_{in}		10	—	—	MΩ
R_{out}		5	—	15	kΩ
Inverter gain		10	—	20	dB
Gain Bandwidth Product		3×10^6	—	—	
Crystal frequency	1	—	1.008	—	MHz
Dynamic Characteristics					
Receiver:					
Signal Input: Dynamic range (50dB SNR)	2,3	100	230	1000	mV rms
Bit Error Rate: 12dB SNR	3	—	7.0	—	10^{-4}
20dB SNR	3	—	1.0	—	10^{-8}
Receiver Synchronization 12dB SNR:	6				
Probability of bit 8 being correct			0.99		
Probability of bit 16 being correct			0.995		
Carrier Detect	6				
Probability of Carrier Detect being high:					
12dB SNR after bit 8	4		0.99	0.98	
12dB SNR after bit 16	4		0.999	0.995	
0dB noise				0.01	
Transmitter O/P					
Tx O/P level		—	775	—	mV rms
Output level variation 1200/1800Hz		0	—	±1.00	dB
O/P distortion		—	3	5	%
3rd harmonic distortion		—	2	3	%
Logic '1' carrier frequency	5	—	1200	—	Hz
Logic '0' carrier frequency	5	—	1800	—	Hz
Isochronous distortion					
1200Hz-1800Hz		—	25	40	μs
1800Hz-1200Hz		—	20	40	μs

Notes: *1. Crystal tolerance depends on system requirements.*
2. See Fig. 3.
3. SNR (Bit Rate Bandwidth).
4. See Fig. 2 Note 5.
5. Depending on crystal tolerance.
6. 101010 Pattern.



Component References

Component	Unit Value	Tolerance %
R_1	1M	±10
C_1	33p	
C_2	1μ	±20
C_3	0.1μ	
C_4	0.1μ	±10
C_5	1μ	±20
C_6	1μ	
X_1	1.008 MHz	Customer
C_7	33 p	Selectable

NOTES:

1. *Bias may be decoupled to V_{SS} and V_{DD} using C_2 and C_6 when input signals are referenced to the bias pin. For input signals referenced to V_{SS}, decouple Bias to V_{SS} using C_2 only.*
2. *Use C_5 when input signals are referenced to V_{SS}, to decouple V_{DD}.*
3. *These inputs must be tied to either V_{SS} or V_{DD}. DO NOT LEAVE FLOATING.*
4. *The value of C_4 determines the carrier detect time constant. A long time constant results in improved noise immunity but increased response time. C_4 may be varied to trade-off response time for noise immunity.*

Fig. 2 External Component Connections

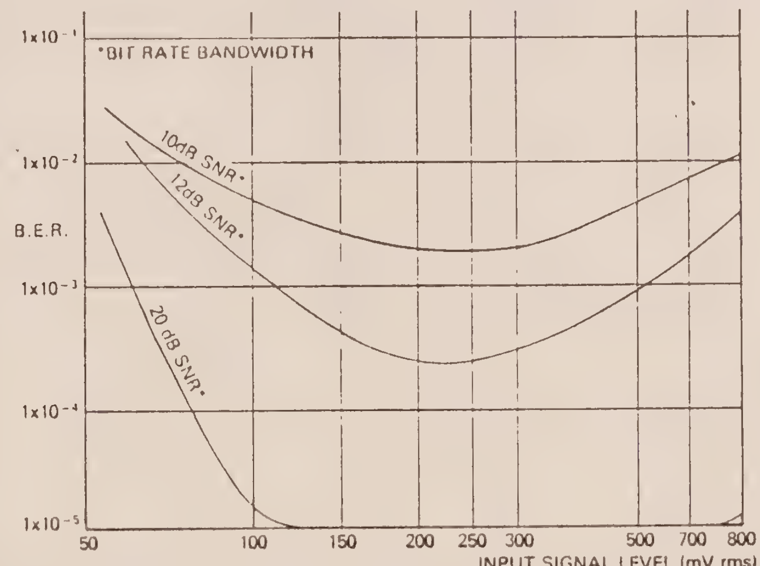


Fig. 3 Typical Variation of 'B.E.R.' with Input Signal Level

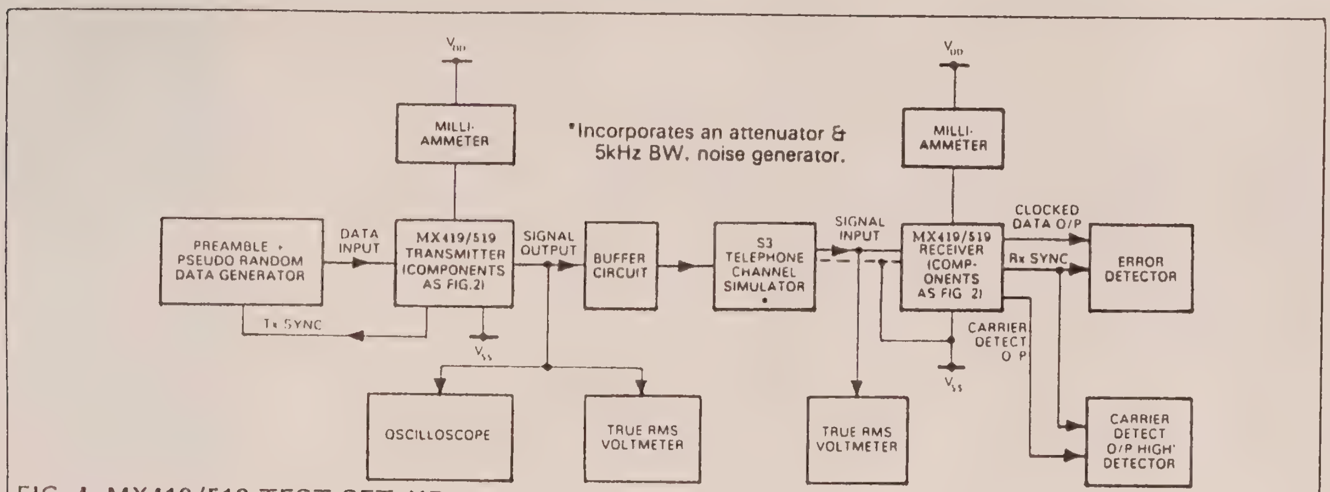
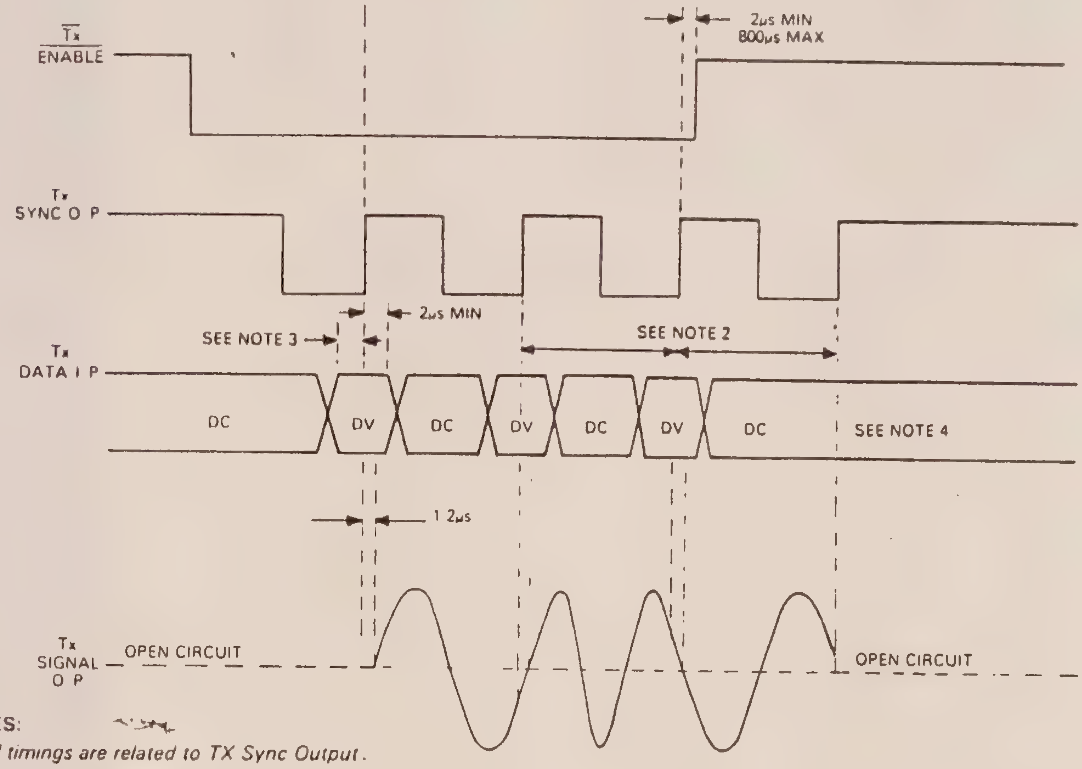


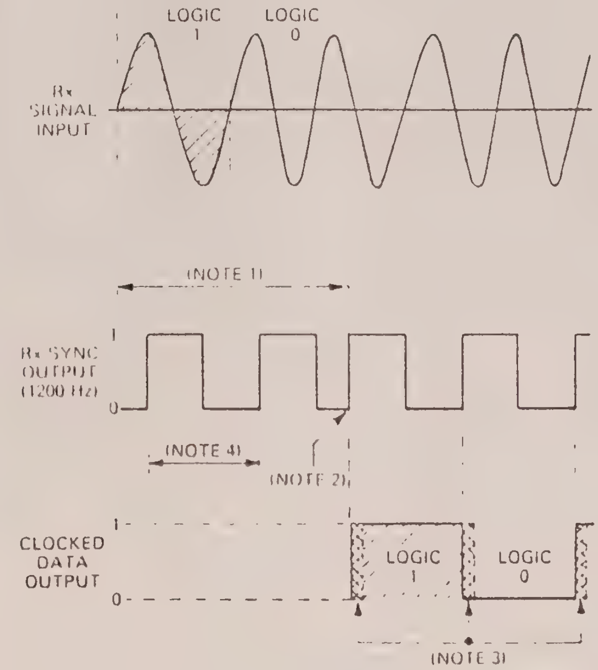
FIG. 4: MX419/519 TEST SET-UP



NOTES:

1. *All timings are related to TX Sync Output.*
2. *0.833ms for 1.008MHz Crystal Input.*
3. *2µs Min + Crystal tolerance*
4. *DC = Don't Care, DV = Data Valid.*

Fig. 5 Transmitter Timing Diagram



NOTES:

1. *Internal Delay-typ 1.5ms.*
2. *From freely running to Sync in 8 data bits (See spec).*
3. *Undetermined state – 2µs max.*
4. *Min. 800µs – Max. 865µs.*

Fig. 6 Receiver Timing Diagram

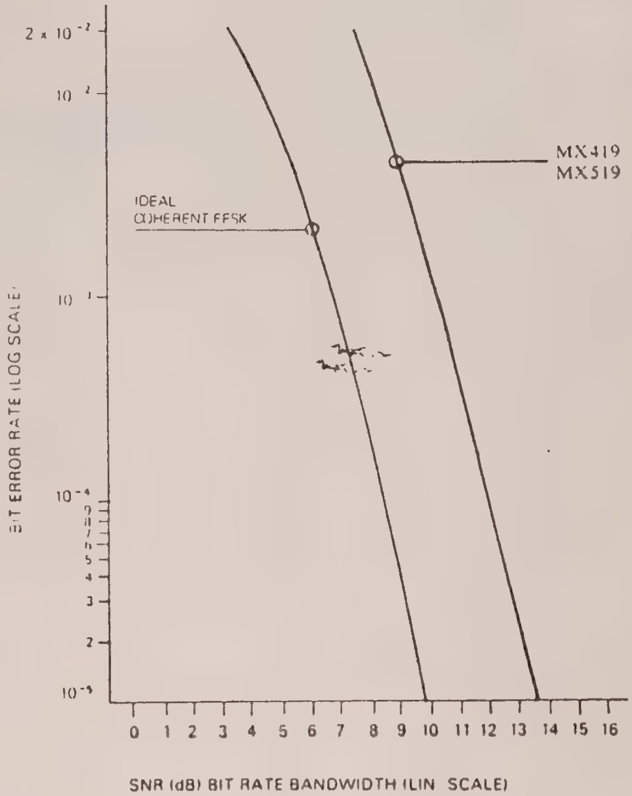


Fig. 7 Receiver B.E.R. Vs SNR

SUGGESTED AX.25 SPECIFICATION CHANGES.

1) PARA 2.4.3.5 NUMBERING.

The numbering of sub-paragraphs 2.4.3.5.1 to 2.4.3.5.3 is incorrect. Para 2.4.3.5.1 refers to half-duplex mode whilst sub-paras .2 and .3 presumably refer to full-duplex mode. A new heading and paragraph number "2.4.3.5.2 Collisions in a Full-Duplex Environment" should be introduced and existing paragraphs relabelled as:-

2.4.3.5.2 becomes 2.4.3.5.2.1
2.4.3.5.3 becomes 2.4.3.5.2.2

2) Disconnect procedure.

Present TNC's such as TNC2 and it's derivatives treat a local stop command as an immediate command and start the disconnect procedure even if there are outstanding I frames. It would be better if the disconnect command were queued with the I frames. In order to take care of the case where an immediate disconnect is required then the double disconnect, ie typing "d" twice should be used. The last ditch disconnect in which a TNC is forced into state 1 outside of state table processing should be taken care of by a separate command. I am not sure whether this is within the scope of the AX.25 specification or not.

3) The RNR Problem.

See separate sheet.

4) The Disconnect problem.

See separate sheet.

5) A standard TNC-host interface should be adopted as soon as possible. The X.3/X.28/X.29 protocols described by VE7APU in the proceedings of the fourth networking conference would be a good candidate. At present, clever host software has to be TNC-specific. A defined software interface which all TNC's implement as a minimum standard would help to simplify this problem.

6) I fully support the implementation of the XID frame, but there will need to be co-ordination of the possible identification codes used. A definition of facilities supported and manufacturer codes will need to be published for the use of all TNC software writers.

G3VPF.
Secretary, SWAX25.
The South-West AX.25 Group.

THE RNR PROBLEM.

THE SCENARIO

Jim is monitoring the packet channel whilst working in the shack and has set MONITOR ON. He is then called away to answer the phone, eat a meal or whatever and hits control-S to hold any incoming information in the TNC until he gets back. Within a few minutes all available memory in the TNC is full due to the monitored multiple retries from another station across town who is trying to work a weak station. At this point Bill tries to connect to Jim and the two tnc's complete the SABM/UA handshake and a connection is established. When Bill sends his first information packet, Jim's tnc responds with an RNR (Receive Not Ready) packet to tell Bill's tnc that he is unable to accept further information frames due to lack of memory space. After a short time, Bill's tnc sends an RR (Receive Ready) packet in order to interrogate Jim's tnc and test to see if it is ready to resume information transfer. Again Jim's tnc responds with an RNR frame. This situation continues indefinitely until either Jim returns and types control-Q to allow the memory to be dumped to the host, or Bill gets fed up and disconnects. Unfortunately, Bill sees no indication of a problem and if he is not familiar with the AX.25 protocol may take some time to realise something is amiss. The only indication of a problem is a lot of transmitter activity. In the mean time, the channel is cluttered up with many RR/RNR exchanges which can occur as often as every 2-3 seconds.

THE REASONS.

The AX.25 specification refers to the use of RNR in several places:-

a) Para 2.3.4.2.2 RNR Command and response.
b) Para 2.3.5.1 DXE Busy Condition.
c) Para 2.4.4.2.2 describes the polling of a busy DXE.
d) Para 2.4.4.7 describes what to do if an RNR frame is received.
e) Para 2.4.4.9 describes the waiting for acknowledgement procedure.

The intended use of RNR is highlighted by the wording of para 2.3.4.2.2 in which the key words are 'temporarily busy'. The procedure defined for using RNR is meant to be used to recover from a situation in which a tnc is unable to handle any more information due to a short term problem, such as the host accessing discs or similar. It was never designed to handle the long term situation in which a tnc becomes busy for long periods whilst unattended. The future implementation of level 3 and higher software will not resolve this problem as the busy condition is not reported to higher levels. The only cure within the present specification is to ensure that the level 2 software never gets into a busy condition. There are several ways of ensuring this:-

a) When memory fills up, new text overwrites the oldest data stored in RAM. When the operator allows host communication to resume he sees only the last RAM's worth of information. This would need a re-write of present tnc software.

b) When memory is full, all incoming information is discarded. The monitor function is suspended until memory becomes available. When the operator allows host communication to resume he sees the first RAM's worth of information to be received after he left the tnc. This would

need a re-write of present tnc software.

WHAT THE OPERATOR CAN DO.

To alleviate the problem, users of present tnc's should observe the following:-

a) NEVER leave a tnc unattended with MONITOR ON and control-S issued.
b) When connecting to an unattended tnc leave short messages only, I frames can fill the memory as well as monitored frames. If you want to transfer a file, leave a message to say the file is available and have the other station call back when he is available.
c) If your host computer has a large buffer capability, leave the host switched-on and allow the tnc to output into this buffer rather than store incoming data internally.

MORE-FUNDAMENTAL CHANGES.

The handling of a tnc becoming busy when unattended can be improved by some minor changes to the AX.25 specification.

1) If a DXE is busy and disconnected, it should respond to a SABM frame with a DM frame, ie an attempt to connect to it should get a busy response. This corresponds to the footnote '*' in fig A1 in the specification. It is not made clear what is meant by "Unable to establish link." Para 2.4.3.1, third sub-para could be re-written to be:-

"If, upon reception of an SABM command, the DXE decides that it cannot enter the indicated state, it should send a DM frame. Conditions which can cause this include lack of buffer space and a local 'connection not allowed' command from the operator or higher protocol layer."

2) A DXE in state 5 (information transfer) which is connected to a device that becomes busy and as a result moves to state 9 (remote becomes busy) should go through the procedure described in para 2.4.4.7 but on moving to the waiting acknowledgement procedure described in para 2.4.4.9, instead of using T1 continually, should use an exponentially increasing time starting at T1 and ending at T3 seconds or, alternatively, try N2 times at T1, then switch to T3. The problem should then be reported to a higher level or the operator, and retries continued at the T3 rate.

3) A DXE in state 8 (device busy) which becomes not busy should act as shown in fig A3 in the specification, ie it should send an RR frame to inform the other station that it is ready to resume I frame transfer and move to state 5. Similarly the remote device, on receiving an RR frame should respond as defined in figs A1 and A2. This does not require any changes to the existing specification, only clarification.

G3VPF.
September 1986

THE DISCONNECT PROBLEM.

THE PROBLEM.

Consider two stations, A and B, connected and both in state 5 as defined in the AX.25 specification. Station A decides to disconnect and issues a local stop command. His TNC sends a DISC packet and goes to state 4 (disconnect request). Whilst awaiting the UA acknowledgement, it receives an RR packet with the P bit set as station B is still trying to send I frames and getting no response from A due to weak signals or interference. On receipt of the RR, station A sends a DM packet and goes to state 1 (disconnected.) When station B receives the DM packet, it attempts to reset the link by sending an SABM and going to state 2 (link set-up). The reset is completed when station A receives this SABM and replies with a UA frame. Both TNC's then go back to state 5 and station B continues sending I frames.

This effect has been observed on several occasions and can be very frustrating if you are station A!. It usually shows if station A has attempted to connect to a weak station, realised the path is so poor that not even the connect message from B is getting through, and then attempted to disconnect. Up to five reconnections by station B have been observed before a mutual disconnection is achieved. If station A had disconnected in a hurry because he had been called away, and station B was unattended, the two TNC's could clutter up the channel for a prolonged period.

THE AX.25 SPECIFICATION.

The specification appears to be written in such a way that the two TNC's do their best to maintain the link. The sequence described above shows that the station reconnectioning wins over the station attempting to disconnect. It could be said that the problem is not a problem but a minor annoyance caused by users improperly using their equipment, however amateurs will always try the difficult path so the specification or implementation should take care of the situation in a better way than at present.

SOLUTIONS.

a) IMPLEMENTATION.

The problem could be lessened if the software recognised that an RR+p received in state 4 was likely to cause problems and to hold the local stop command rather than discarding it as soon as state 1 is entered. An SABM from the same station would be replied to with a UA as required in the specification but as soon as state 5 is entered, the TNC would immediately try and carry out the local stop command and restart the disconnect procedure. The local stop command would only be removed if no further connected mode packets from station B were received within a fixed time.

b) SPECIFICATION.

An alternative to the above, which is somewhat cumbersome, is to change the entry for state 4 so that any connected-mode packet received with the P bit set is replied to with a DISC command packet and no state transition. The only way back to state 1 should be by receipt of a UA or DM packet or by N2 being exceeded. The proposed modification is shown on the enclosed revised state table. This modification is completely compatible with existing AX.25 version two TNC's.

G3VPF.
NOVEMBER 1986

The Radio Amateur Telecommunications Society
206 North Vivyen Street
Bergenfield, NJ 07621

11 November 1986

Proposal for Transport of NTS Traffic
via Packet Radio Message Systems

Based on the input of several dozen amateurs active in NTS, Packet Radio and software development the following assumptions have been made:

1. No format change would be required of NTS operators unless it was done as part of a general overhaul of NTS and Packet Message content description practices;

   (NOTE: We have the desire to move toward X.420 Interpersonal Messaging formats and protocols.)

2. NTS messages (Headers, text, et al) would be carried as "data" in a packet mail envelope;

3. The BBS software would assign a message number to new messages, add in the default Precedence (R), parse for the Precedence and Handling Instruction (if required), insert the originators callsign, calulate the check, enter the location of the BBS (City, State) and add in the Time and Date.

4. No on-line editing of messages would be provided by the packet mail systems;

5. Implicit routing tables in the BBSs would be used to get NTS traffic as close to the destination as possible.

6. NO special table entries in the BBS forwarding files would be required to relay NTS traffic via the Packet Network. (ie. NTSNY)

Therefore, the NTS Message:

NR 123 R HXG W2VY 8 Clifton NJ 1700Z March 13
BT
Gail Moulton
10 Desert Ct
Sandpit CA 99999
714 555 1234
BT
Pick you up at the airport at dawn
BT
Tom

OK how should this message be entered into NTS via the Packet Network ?

The "user" (W2VY) would log on to a BBS and then send the traffic as follows:

ST NTS @ CA   or (ST NTS @ 714)   714NNN

The system would then prompt for header data instead of the normal "subject".

The "user" would reply:

R HXG

The system would parse this and then prompt for the message and the "user" would send the Address, Text and Signature parts of the message as they appear above.

OK so what ?...we got the message entered. Now what has the system done to the message ? Did an NTS Preamble line get built ? What does it look like ?

Msg#	TRP	Size	Read	To	@ BBS	From	Date	Time
123	TN	190	0	NTS	714NNN	W2VY	860313	1700Z

NR 123@KD6TH/03100201 NNN R HXG W2VY 8 Clifton NJ 1700Z March 13

Gail Moultory
10 Desert Ct
Sandpit CA 99999
714 555 1234

Pick you up at the airport at dawn

Tom

OK now that we have the message, how is it going to get out of here ?

The BBSs have a known path that can get ANY message (NTS or ALL) to "714" or "CA" so we can let the BBS's tables drive it through.

OK that's fine and dandy, but what happens if there is an existing message that needs further routing to get closer to the destination, but it has already traveled many miles as a non-packet message ?

The "user" would enter a slightly different command than he did to get the header built for him by the BBS.

```
STR NTS @ CA                                  or ( STR NTS @ 714)


Msg# TRP   Size Read To         @ BBS   From        Date   Time
5487 7N     190    0 NTS        714     W2VY      860315  0817Z

NR 123 R HXG W2VY 8 Clifton NJ 1700Z March 13

Gail Moulton
10 Desert Ct
Sandpit CA 99999
714 555 1234

Pick you up at the airport at dawn

Tom
```

This entry method uses the "R" option which is "relay" and turns off the special construction of the Preamble by the BBS.

OK that's it ! We've discussed this approach here in NJ/NY, programmers are willing if they can have a stable target to code.

Please provide comments to N2DSY @ KD6TH/201 or call Gordon Beattie at 201-387-8896.

Post Office Box 205
Holmdel, NJ 07733
201-671-8107 [R]
201-834-1149 [B]
April 30, 1987

Mr. Paul Rinaldo, W4RI
Chairman, ARRL Ad Hoc Committee
on Digital Communications
American Radio Relay League
225 Main Street
Newington, CT 06111

Dear Paul:

Enclosed is a document that I would like to submit to the Digital Committee for its consideration. If the document is of interest, I would ask that the Committee circulate it among vendors for comments and then, after comments are included, consider the result for adoption as a recommendation or application note by the Digital Committee. The document provides an interface specification for interconnecting audio tone modulators and demodulators (modems) to HF Single-Side-Band (SSB) radios. I have taken it upon myself to write this document because of discussions during and after the Dayton 87 Hamvention RTTY forum. I have done so in hopes that most manufacturers will follow the final recommendations, to the extent they can where cost increases are minimal, to ensure compatibility between all equipment regardless of manufacturer.

At this point, the document is a draft of one person's opinion. I would like to solicit comments from others to improve its value. To ensure that comments are incorporated correctly into this document, I suggest that the people you distribute it to carefully mark up their copy to read exactly as they want it to and then return it to me at the address listed above. Without specific written comments, it is possible that suggestions may not be completely or correctly incorporated into the next revision of the document.

Thanks for your support and interest.

Sincerely,

Paul Newland, ad7i

Copy (w/encl) to:
Craig Martin, Trio-Kenwood

An Interface Specification for Interconnecting Single-Side-Band Radios to Audio Modulators and Demodulators

Paul Newland, ad7i
Post Office Box 205
Holmdel, New Jersey 07733
201-671-8107 [R]
201-834-1149 [B]

Abstract

This document provides an interface specification for interconnecting audio tone modulators and demodulators (modems) to HF Single-Side Band (SSB) radios. The specifications contained in this document are, of course, non-binding on anyone. However, it is hoped that most manufacturers will follow the final recommendations, to the extent they can where cost increases are minimal, to ensure compatibility between all equipment regardless of manufacturer.

This document is a draft of one person's opinion. Comments are hereby solicited to be incorporated into the document to improve its value to the users of HF radio AFSK data communications. To ensure that your comments are incorporated correctly into this document, I suggest that you carefully mark up this copy to read exactly as you want it to and then return it to me at the address listed above. Without specific written comments, it is possible that your suggestions may not be completely or correctly incorporated into the next revision of the document.

In general, the approach of large amplitude signals on low impedance lines is used to mitigate Radio Frequency Interference (RFI) problems. A nominal impedance of 600Ω was chosen as its is commonly used for wire transmission systems and the VSWR is less then 1.2:1 when driving older 500Ω lines. RCA jacks and plugs are recommended on both the modem and the radio as they are commonly available and easily lend themselves to constructing shielded cables.

An Interface Specification for Interconnecting Single Side-Band Radios to Audio Modulators and Demodulators

CONTENTS

An Interface Specification for Interconnecting Single-Side-Band Radios to Audio Modulators and Demodulators

Paul Newland, ad7i
Post Office Box 205
Holmdel, New Jersey 07733
201-671-8107 [R]
201-834-1149 [B]

1. Purpose

This document provides an interface specification for interconnecting audio tone modulators and demodulators (modems) to HF Single-Side-Band (SSB) radios. It is the result of some discussions that took place during and after the 1987 Dayton Hamvention RTTY forum. It is my hope that the document can be submitted to the ARRL Digital Committee for publication as a recommendation or application note to help guide manufacturers and home-brewers of RTTY equipment. This document is a draft and in no way necessarily represents the views or opinions of anyone other than myself.

1.1 Providing Comments

Comments on this document are solicited and encouraged. To ensure that your comments are incorporated correctly into this document, I suggest that you carefully mark up this copy to read exactly as you want it to and then return it to me at the address listed above. Without specific written comments, it is possible that your suggestions may not be completely or correctly incorporated into the next revision of the document.

1.2 Approach

In general, the approach of large amplitude signals on low impedance lines is used to mitigate Radio Frequency Interference (RFI) problems. A nominal impedance of 600Ω was chosen as its is commonly

used for wire transmission systems and the VSWR is less then 1.2:1 when driving older 500Ω lines. RCA jacks and plugs are recommended on both the modem and the radio as they are commonly available and easily lend themselves to constructing shielded cables.

1.3 Non-binding Obligation

The specifications contained in this document are, of course, non-binding on anyone. However, it is hoped that most manufacturers will follow the final recommendations, to the extent they can where cost increases are minimal. Doing so should ensure equipment compatibility between different manufacturers.

1.4 Companion Proposals

One additional paper has been completed and another is in the works that cover other topics involving HF data communications. The first paper describes the measurement of TX/RX switching times. The switching time test procedure was documented on pages 8 and 9 in the March 1987 issue of *QEX* in the article "How to Measure Transceiver TR Switching Times" by Paul Newland, ad7i. The second paper, which is in the works, discusses the importance of independent selection of filters, AGC characteristics, USB/LSB, etc., for radios.

2. Definition of Terms

Different terms are applied to different functions within the data communications system. This section defines some of the terms to help ensure that all users are viewing this document from a common vantage point.

Receiver	A receiver is a device that detects signals that travel on RF carriers and converts these RF signals to IF or AF signals that are then made available to other systems.
Transmitter	A transmitter is a device that changes (or modulates) a RF carrier in a prescribed manner based on an input AF or IF signal.

Transceiver — A transceiver is a device that contains both a receiver, transmitter and a device to control antenna switching between the two.

Modulator — A modulator is a tone (possibly multiple simultaneous tone) generator whose amplitude, phase, and/or frequency is changed based on a digital data input signal.

Demodulator — A demodulator is a device that detects AF tone signals and converts them to data signals for a computer or other digital device to handle.

Modem — A modem is a device that contains the functions of both the modulator and demodulator.

3. Audio Measurements

The audio measurements called for in this document are done with a scope rather than a RMS voltmeter to avoid problems when using complex waveforms or multi-tone systems. Additionally, a discussion of open circuit versus terminated circuit voltages is provided. It is meant as a tutorial; most readers can skip it.

3.1 Open Circuit versus Terminated Circuit

Sometimes people get confused when they measure output voltages of line drivers. The discrepancy usually involves the use – or lack of use – of a termination. The difference leads to a doubling or halving of the expected voltage (6 dB). Double termination usually leads to a 30% drop in voltage (or 3 dB change). The equivalent circuit for the interconnection of the audio output of a SSB radio to the input of a demodulator is shown in Figure 1. The voltage output of the radio can be modeled as a voltage source that can supply infinite current in series with a resistor that represents the output impedance. Another resistor of the same value is assumed to represent the input to the demodulator. These two resistors set the impedance of the circuit *and act as a 2:1 voltage divider.* Thus, the voltage delivered to the demodulator is half that provided by the perfect voltage source within the radio. If the radio's output impedance goes to a small value (less than 60Ω) the voltage divider effect has been

removed and almost the full value of the perfect voltage source appears at the demodulator's input. This makes the radio's output voltage look like it doubled. It didn't, even though the voltage delivered to the demodulator did double.

Conversely, if the radio's output impedance remains at 600Ω and the demodulator's input impedance increases to a large value, (above 6 KΩ), then, again, the voltage divider has been distroyed and the voltage delivered to the demodulator has doubled.

In some cases it is helpful to run with mismatched impedances. However, in most installations, it's best if the source impedance matches the load impedance.

3.2 Voltage Amplitude Measurements

All audio output measurements should be made with a calibrated scope measuring across a 600Ω load resistor and reported as peak-to-peak (pp) voltages. Nominal signal level is 2.2 Vpp which, for a sine wave, is equivalent to 775 mVrms or 0 dBm when terminated in a 600Ω load. Avoid the use of RMS meters or conversions to RMS as it's the peak voltage that matters to a SSB radio (when flat-topping, for instance). A possible peak-to-peak adapter for a DC voltmeter is shown in Figure 2 for the benefit of home-brewers who may not have access to a scope.

4. Transmitter Control -- TXON Circuit

The on/off control of the transmitter is done over the TXON circuit. The circuit consists of a power source and current sensor in the transmitter plus a current sink in the modulator. An example of a circuit that may be suitable for use as a TXON control and driver appears in Figure 3.

4.1 Connector

The connector for the TXON circuit on both the modulator and the transmitter shall be a coaxial RCA connector.

4.2 Transmitter TXON Sensor

The TXON circuit operates similar to most PTT circuits. However, it is modified to ensure that it doesn't present an inductive load to the driving circuit and that it isn't susceptible to RFI. The TXON circuit consists of a positive voltage source of less than 20 volts that is current limited to less than 50 mA (when connected to ground). At currents of less than 100 μA, the transmitter must remain OFF. At currents of more than 10 mA the transmitter must be ON.

4.3 Modulator TXON Driver

The modulator will provide a path to sink current from the transmitter's TXON circuit to ground when the modulator wants the transmitter to be activated. The maximum voltage of the transmitter's TXON circuit will be less than 20 volts DC. The maximum current of the transmitter's TXON circuit will be less than 50 mA when connected to ground. The transmitter's TXON circuit will not present a significant inductive reactance. A leakage current of less than 10 μA will ensure that the transmitter is off. Allowing at least 25 mA to flow from the transmitter's TXON circuit will ensure that the transmitter is on.

5. Radio Receiver Audio Output

This section describes the audio output circuit for the radio receiver. An example of a circuit that may be suitable for use as an audio output driver appears in Figure 4.

5.1 Connector

The connector for the radio receiver audio output shall be a coaxial RCA connector.

5.2 Impedance

The impedance, measured over the frequency range of 300 Hz to 5 KHz, shall be, nominally, 600Ω. The output circuit shall be blocked by a capacitor within the radio of at least 10 μF and suitable working voltage. Note that this means a DC ohm meter should measure infinite resistance between

this output and ground.

5.3 Amplitude

The amplitude of the signal at this output is NOT affected, in any way, by the front panel AF gain control. The nominal amplitude of this output signal shall be 2.2 Vpp (Volts peak-to-peak). The maximum amplitude of this output signal shall not exceed 4.4 Vpp; a limiter may be included within the receiver to ensure that larger levels are compressed or limited. When AGC is on, the minimum signal output amplitude shall be greater than 220 mVpp. These tests are made by connecting a CW signal generator to the receiver and varying the generator level from 1 μVrms (-107 dBm) to 225 mVrms (0 dBm) in 6 dB steps (or less) while noting the minimum and maximum audio output signal amplitudes. No manual adjustment of RF gain, IF gain, or attenuators is allowed during these tests.

5.4 Transient Voltages

Any transient voltage generated by the receiver, such as might be caused when going from a squelched condition to an unsquelched condition, shall be constrained to occur within the first 5 mS of the change in condition and shall have a zero-to-peak level no greater than 6 dB above the zero-to-peak voltage of the steady state amplitude of the nominal tone output.

6. Radio Transmitter Audio Input

This section describes the audio input circuit for the radio transmitter. An example of a circuit that may be suitable for use as an audio input conditioner appears in Figure 5.

6.1 Connector

The connector for the radio transmitter audio input shall be a coaxial RCA connector.

6.2 Impedance

The impedance, measured over the frequency range of 0 to 5 KHz, shall be, nominally, 600Ω. Note that this means a DC ohm meter should measure about 600Ω to ground on this input.

6.3 Amplitude

The nominal amplitude of this input signal shall be 2.2 Vpp (Volts peak-to-peak). The maximum amplitude of any input signal shall not exceed 8.8 Vpp (Volts peak-to-peak); a limiter may be included within the transmitter to ensure that larger levels are compressed or limited. The transmitter shall be capable of reaching full rated transmitter power with any input signal level greater than 200 mVpp, perhaps by adjusting the front panel microphone gain control to maximum.

7. Modulator Audio Output

This section describes the audio output circuit for the tone modulator. An example of a circuit that may be suitable for use as an audio output driver appears in Figure 4.

7.1 Connector

The connector for the radio receiver audio output shall be a coaxial RCA connector.

7.2 Impedance

The impedance, measured over the frequency range of 300 Hz to 5 KHz, shall be, nominally, 600Ω. The output circuit shall be blocked by a capacitor within the modulator of at least 10 μF and suitable working voltage. Note that this means a DC ohm meter should measure infinite resistance between this output and ground.

7.3 Amplitude

The nominal amplitude of this output signal shall be 2.2 Vpp (Volts peak-to-peak). A user adjustment may be provided to increase this signal to no greater than 4.4 Vpp or reduce this signal by any amount.

7.4 Muting

The tone output shall be reduced by at least 55 dB whenever the TXON circuit is de-energized. This feature may be disabled by the user, so that the tone output is always activated.

7.5 Transient Voltages

Any transient voltage generated by the modulator, such as might be caused when going from a tone off condition to a tone on condition, shall be constrained to occur within the first 5 mS of the change in condition and shall have a zero-to-peak level no greater than 6 dB above the zero-to-peak voltage of the steady state amplitude of the nominal tone output.

8. Demodulator Audio Input

This section describes the audio input circuit for the radio transmitter. An example of a circuit that may be suitable for use as an audio input conditioner appears in Figure 5.

8.1 Connector

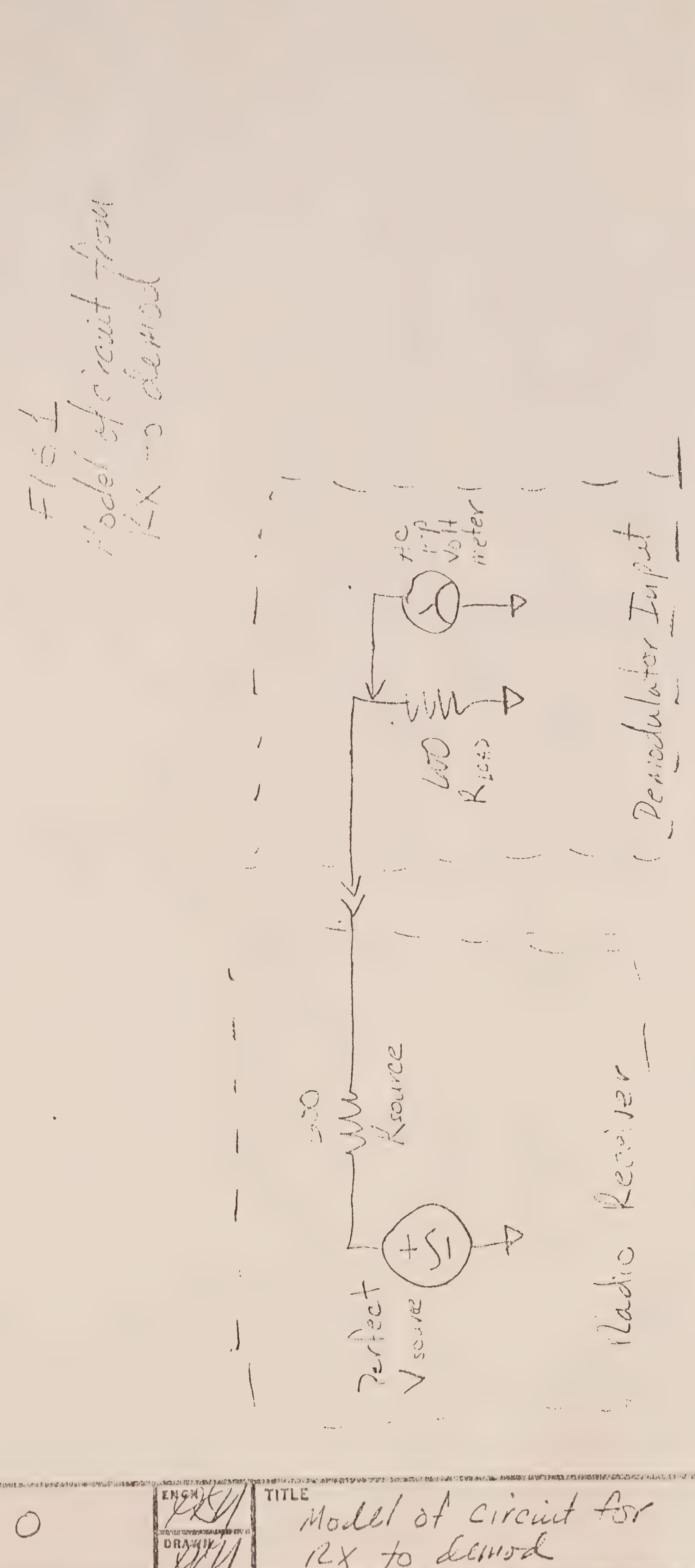
The connector for the radio transmitter audio input shall be a coaxial RCA connector.

8.2 Impedance

The impedance, measured over the frequency range of 0 to 5 KHz, shall be, nominally, 600Ω. Note that this means a DC ohm meter should measure about 600Ω to ground on this input.

8.3 Amplitude

The nominal amplitude of this input signal shall be 2.2 Vpp (Volts peak-to-peak). The maximum amplitude of any input signal shall not exceed 8.8 Vpp; a limiter may be included within the demodulator to ensure that larger levels are compressed or limited. The demodulator shall be capable of detecting and using input signal amplitudes greater than 50 mVpp.



ISSUE

ISSUE	ENGR	TITLE	FIG	AT&T Bell Laboratories	SHEET
0	DRAWN	Model of circuit for RX to demod	1	870428	
				NO. OF SHEETS PER SET	

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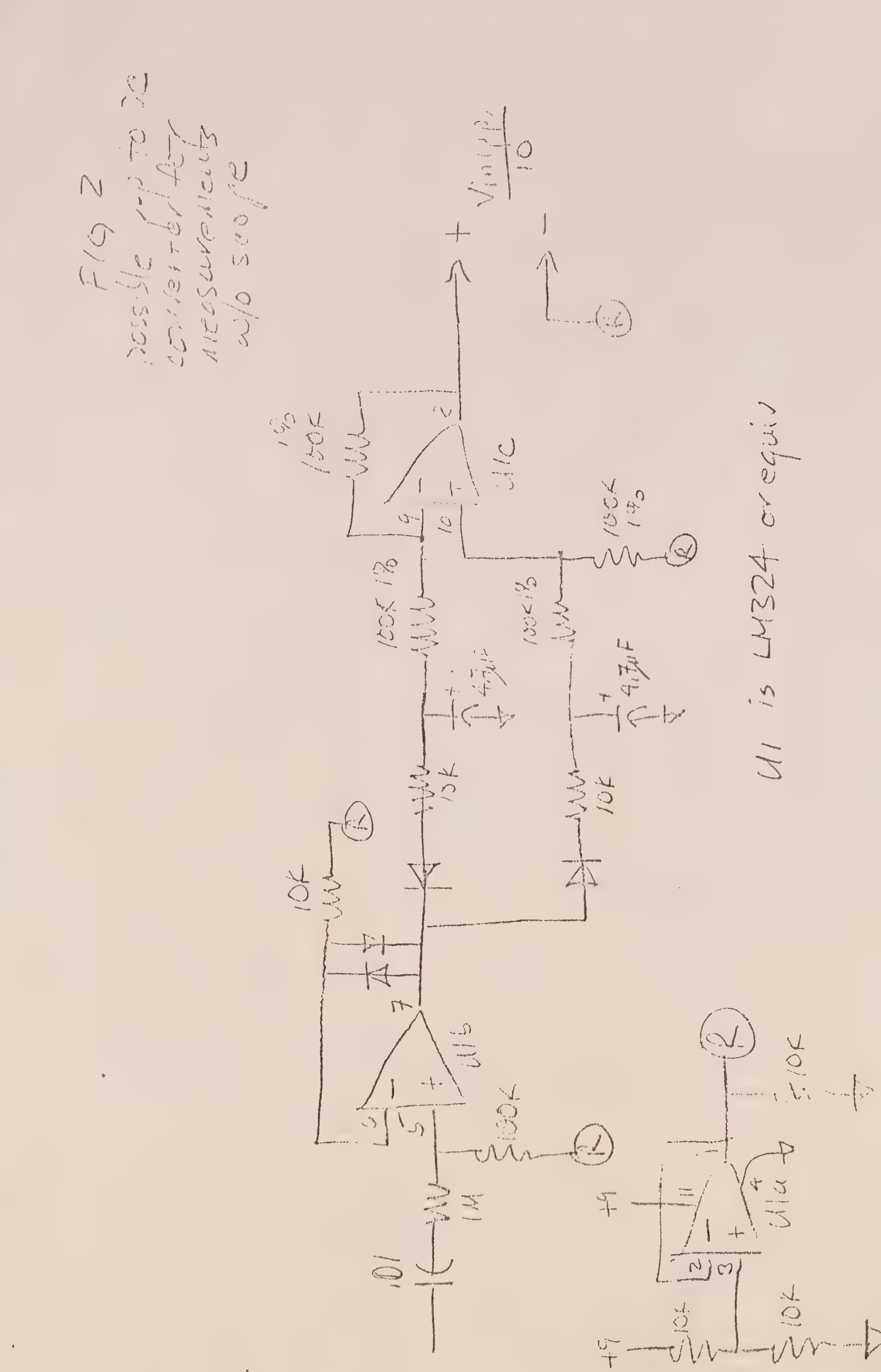
E-1612-A-1(3/84)



ISSUE
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ENGR
DRAWN

TITLE
possible circuit for pp voltmeter

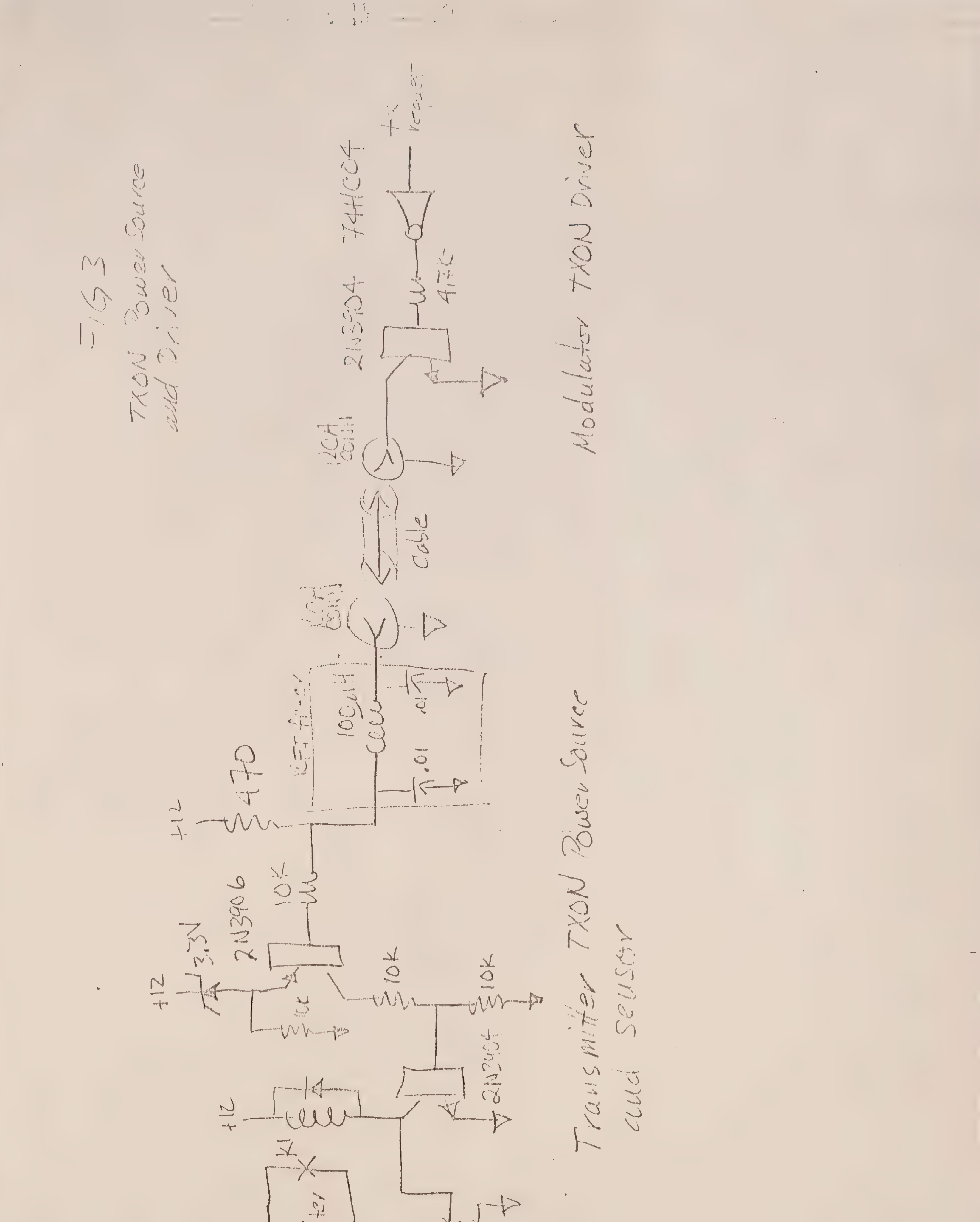
FIG 2

AT&T Bell Laboratories

670501

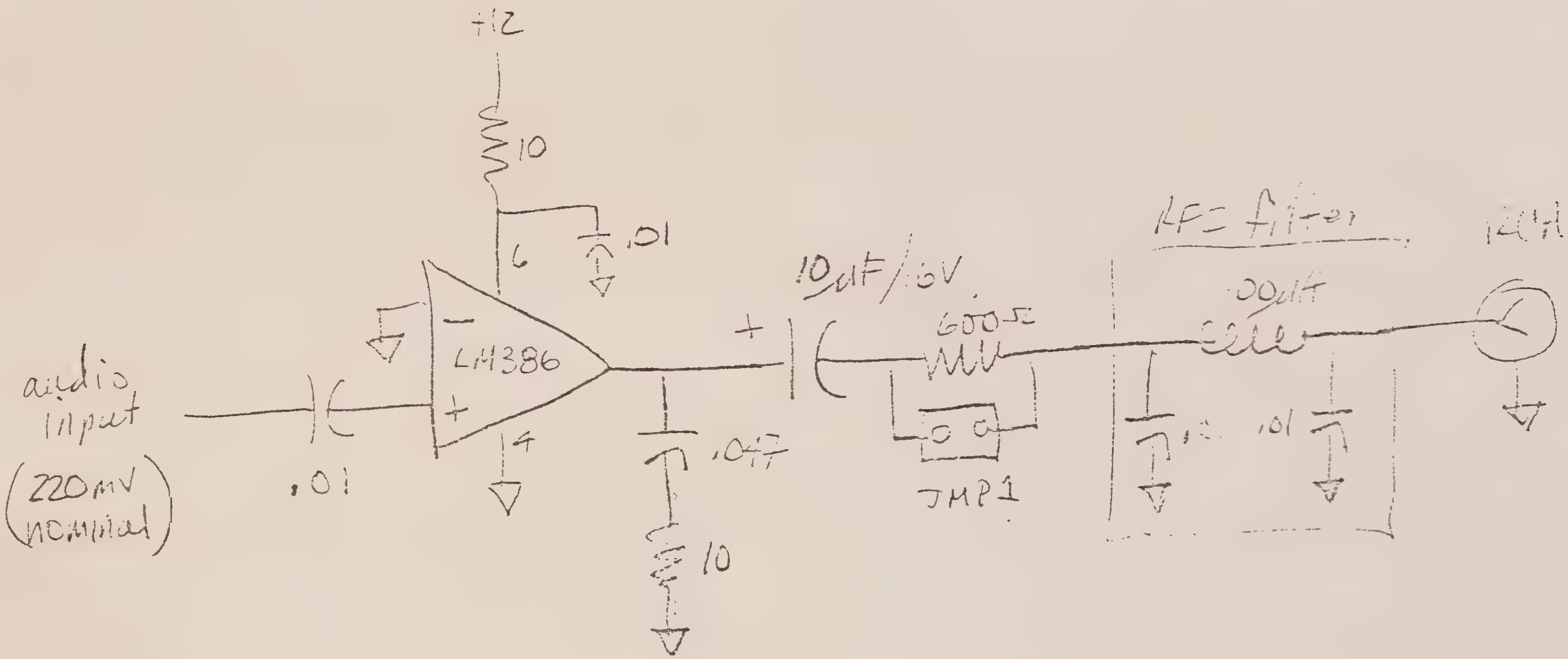
SHEET

NO. OF SHEETS PER SET



ISSUE	ENGR	TITLE	AT&T Bell Laboratories
0	DRAWN	Possible TXON Power Source, sensor & driver circuits Fig 3	870428
			NO. OF SHEETS PER SET · SHEET

FIG 4
possible audio output circuit



Notes 1) Install JMP1 for very low impedance output

2) Most op-amps can't drive a 600 load to 4.4 Vpp. Thats why an audio driver chip is recommended

3) The output impedance of the popular XR2206 is 600Ω and can have an open circuit voltage in excess of 4.4 Vpp.

ISSUE 0

TITLE Possible audio output circuit FIG 4

AT&T Bell Laboratories

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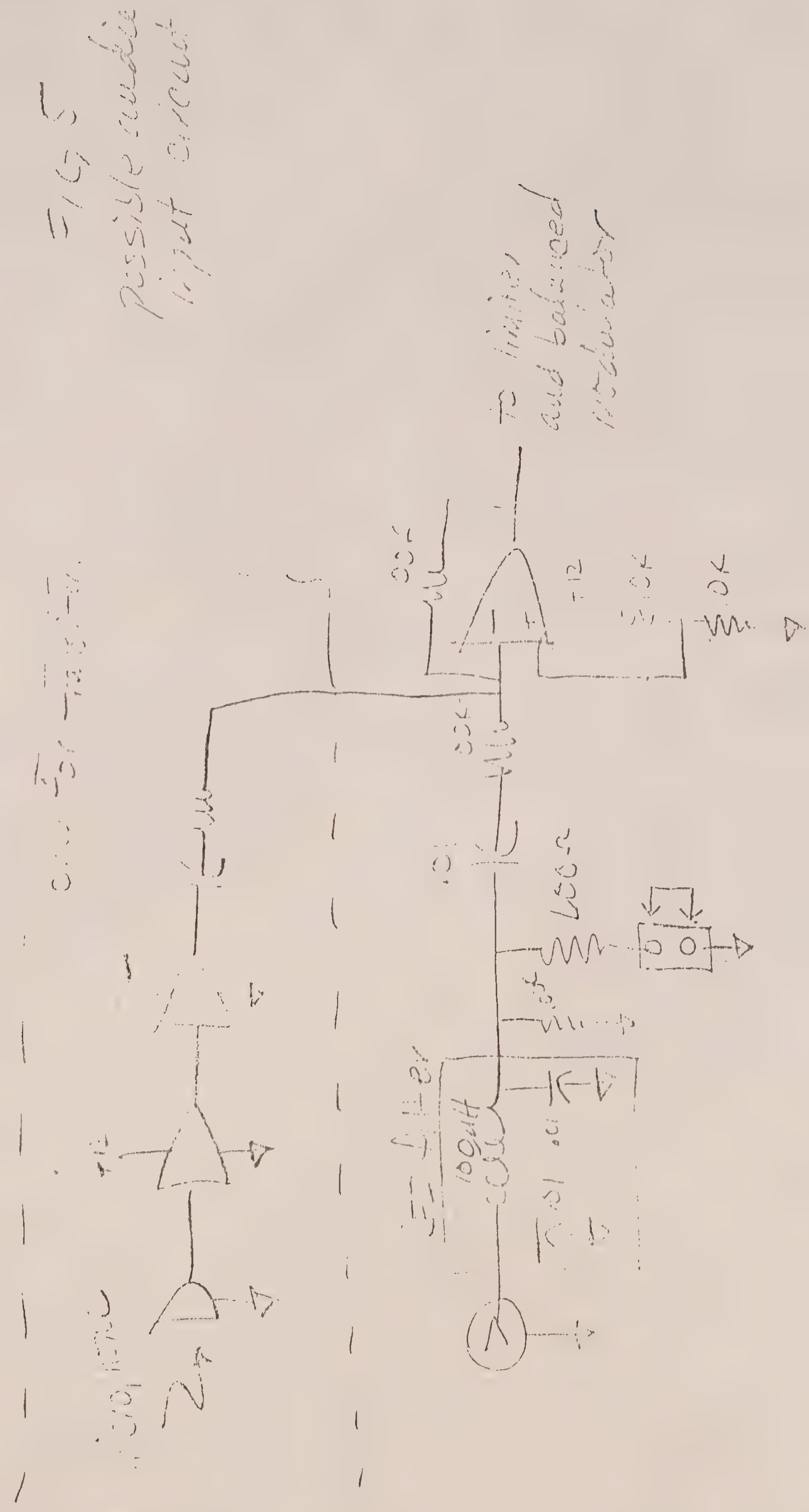


ISSUE	ENGR	TITLE	AT&T Bell Laboratories
0	DRAWN	Possible audio input circuit FIG 5	870428
			SHEET
			NO. OF SHEETS PER SET

35 Wynford Hts. Cr. #1708
Don Mills, Ontario, Canada
M3C 1L1
Dec. 3, 1986

TAPR
Tucson, Az

Dear Lyle,

Thank you for the opportunity to express my views on the AX.25 protocol (AX.25 Works...., PRM October, 1986). I would like to make a suggestion regarding the use of the poll/final bit and the definition of the command/response bits in the header.

In my opinion the poll/final bit is improperly used in the AX.25 protocol. And for some reason, instead of correcting this, the command/response bits were defined in version 2. The result is ambiguous and confusing, and resulted in the regrettable Appendix C to the AX.25 Version 2 protocol published by ARRL.

I would like to suggest that the command/response bits in the SSID be dropped from the protocol (or given a more useful function), and the poll/final bit be used in a proper manner. Because of the balanced nature of the sessions, the bit may be referred to as the poll bit only. This bit should be set to one when a response is required, and zero when no response is required. (This is in accordance with the usage in the Vancouver V1 and V2 protocols.)

73,

Jack Botner

Jack Botner, VE3LNY

****
ROUGH DRAFT
****

Proposed modification to AX.25 protocol.

The effect of implementing this proposal will be to reduce the offered load to the channel. This will be accomplished by reducing unnecessary collisions, many of which are due to a complete lack of consideration of the real world limitations of modems, radios, and propagation in the original specification. The x.25 basis for AX.25 is optimised for 2 stations communicating over a wire. It does not handle a channel with multiple stations (some of which may not be able to hear each other) very well at all. It is not sufficient to simply poll a very unreliable DCD output from the modem to prevent collision on a half duplex radio channel mode.

I recently did a fairly extensive comparison test of HF modems. During these tests I noticed that a large fraction of the traffic on a busy HF channel is retried frames which had been copied and acknowledged by the intended receiver but were retried anyway. At first I put these down to propagation related problems on HF preventing the originating station from hearing the acknowledgements. Then I took a close look at one of the busy simplex VHF channels. I was surprised to find the same phenomenon up at "line of sight" frequencies.

To illustrate the problem let me describe a hypothetical but very plausible scenario. Lets say that there are 4 stations, A, B, C, and D. These stations are all located on a straight line. Their relative proximity is such that A can hear only B, B can hear A and C, C can hear B and D, and D can only hear C. A is connected to B and C is connected to D. It is clear that there will be collisions on the channel due to hidden terminals, however, some of these can be prevented. It turns out that the ones which can be prevented are also the most important ones to prevent. Consider the case where both B and C attempt to access the channel with I frames for A and D respectively. The coin is tossed and B wins. B sends his I frame to A who copies it correctly and responds with an acknowledgement. Unfortunately, C cannot hear the acknowledgement from A and since he has been impatiently waiting for the channel, C now sends his I frame. Crash! B is now prevented from knowing that his packet got through ok. Notice that this type of collision is virtually guaranteed since the I frame is usually the longest type of transmission. Once an I frame is initiated by one of the "inner" stations, it will cause the other "inner" station to synchronize his transmission in exactly the worst possible manner. If B was permitted to hear the acknowledgement, he would not have to unnecessarily load the channel again with the same data which has already been copied and acknowledged by A. The busier the channel is, the more likely this type of "synchronized" collision becomes. With only a small number of simultaneous users, the channel throughput is drastically reduced long before the theoretical 60% loading factor is reached.

But wait, there is more! It is relatively easy to see that unless everyone on the channel (even the ones who can't hear each other) agrees to adhere to a fairly carefully thought out set of DWAIT, RESPONSETIME, and FRACK parameter settings, the current protocol will not only result in lousy throughput due to unnecessary retries, but will frequently degenerate into 0 throughput until one end or the other gives up and disconnects. This can easily happen even with only the 2 QSOs described above on the channel.

Of course, not all of the collisions on a channel with hidden terminals can be prevented. However, collisions of the type described above CAN be prevented. If a packet and its acknowledgement are considered as a unit, with no time unrelated to radio and modem hardware limitations allowed to

intervene, the situation can be improved greatly. All that is necessary is for all stations who are waiting for DCD to drop (on anything but an acknowledgment) and do not intend to acknowledge the packet currently being sent to wait for a period equal to the time required for an acknowledgement before starting their channel access sequence (more about this sequence later). Of course if copy isn't good enough to tell if an acknowledgement being sent, the assumption should be that it is a packet requiring an acknowledgement. Also required is for the addressee station to send an acknowledgement Immediately (don't bother to check the state of DCD) upon receipt of a valid I frame. Unfortunately (or fortunately) this implies the elimination of multiple frame packets. While there are other reasons for eliminating the multiframe packet, I won't go into them here. I will say that if the link quality is indeed good enough to support multiframe packets, it is good enough to support very long (certainly 7*255 byte long) single frame packets.

But wait, there is more! When I began writing this I was laboring under a severe misconception. I had assumed that the random backoff timer used by most TNCs to prevent repeated collisions on retries was a part of the AX.25 specification. When I searched the published AX.25 specification, I was shocked to find absolutely no mention of this crucial timer. Since this is a relatively critical part of any packet controller implementation, I had assumed that it would be included in the only document a new software writer has available to use for guidance. It is NOT reasonable to expect that someone who can write the code to implement a TNC is necessarily knowledgeable about either telecommunications systems in general or the real world limitations of hardware (radios and modems) in particular.

I discussed this oversight with Dan and Margaret Morrison. They informed me that the reason for this oversight is probably that this timer is considered a level 1 issue and the specification is a level 2 document. I would like to strongly suggest that we dispense with the level 1 versus level 2 argument and include information of this nature in the specification regardless of which level of the protocol it is actually under. To do otherwise is to guarantee much wasted channel time.

My discussion with the Morrisons brought me another relatively large surprise (and some insight as to why the collision frequency is so high on an AX.25 channel). While we were discussing the backoff timer, I discovered that it is only invoked once the TNC suspects that there may have been a collision, that is, on retries. Actually, to be most useful, this timer should be used every time a channel access sequence is initiated by the TNC. As it stands now, when a channel is being used by several stations who all have the same DWAIT value set into their TNCs, a collision is guaranteed every time 2 stations que up to send the first try of any type of frame while waiting for the third station to complete the sending of its packet. As soon as DCD drops, both stations in the que will wait DWAIT seconds and then key up simultaneously. If a random delay was selected by each TNC on each channel access, the likelihood of a collision would be greatly reduced.

I initially began looking at the random timer with the idea of clarifying in my own mind the granularity being used. I wanted to be sure that the granularity was long enough to account for the delays introduced by real radios and modems. The granularity should be longer than the time between radio keyup by station A and DCD going true in station B's demodulator. This time will include the delays for such things as squelch circuit delay on VHF NBFM AFSK for instance and the delay in the demodulator being used. None of the demodulators provides detection of the data carrier on an instantaneous basis. Again, I'm sure that there will be screams of "level 1 issue!" but please let us not get hung up on this point. The fact is that if this information is not covered in the specification document, it will be overlooked by future writers of code to implement AX.25. It may not necessarily be included in the level 2 specification but the information should at least be included in the document.

Once a potential AX.25 implementer has been made aware that there are some level 1 issues that bear on the code he is writing to implement level 2, it would be very useful if there was a source of information available to him defining acceptable performance characteristics for modems and radios to be used on packet. This is an area where both TAPR and the league can provide valuable leadership. Two things would be useful here. First, some guidance on what constitutes acceptable performance for use on a packet channel. Second, inclusion of measured values for these critical parameters in all equipment reviews..........

N7CL

NOTE NEW ADDRESS →

11 Dormy Way
Gosport
Hants
PO13 9RF

21st April 1987

Mr Paul L Rinaldo
A R R L
Newington CT
06111
U S A

Dear Mr Rinaldo,

Thank you for your letter of 8th April concerning AMTOR, and thank you for the opportunity to comment on this subject.

I could start by commenting that no change to the rules is neccesary, or even desirable, I was invloved with AMTOR from the very beginning, and worked closely with the group of U S amateurs who took part in the activities under the FCC's S.T.A. The wording "AMTOR code, baud-rate, and emission timing shall conform to CCIR 476-2" was very carefully chosen at the time so as to impose the least possible restriction on the future development of AMTOR, while still keeping some control over future compatability. It would have been very easy to simply specify that "AMTOR operation shall conform with CCIR 476-2". Incidently, 476-3 did not change the code, baud rate, or emission timing, so there was really no need to amend the rule to include reference to 476-3 after 1983. The same can be said of 476-4, and indeed of 625, hence my suggestion that no change is neccesary.

However, taking a more positive view, it is indeed worth studying the latest CCIR documents and considering what changes, if any, might be beneficial. It seems to me that two questions are worth asking: (1) Do we want AMTOR to be more precisely-defined than it is at present, and if so, are we prepared to accept the CCIR definition as it stands, or do we have better ideas? (2) Does CCIR 625 have something to offer to the extent that we would wish to ask for permission to use it, and if so, do we accept CCIR definition.

My answer to the first question is a qualified no. The requirements of AMTOR in the amateur radio field are significantly different to those of the non-amateur field, and may continue to diverge. We should hope to keep the precise specification under our own control as much as possible. My qualification is that at the moment we only have "control" in that we have resisted imposition of "control" from outside, but we have not formalised the definition of what we call AMTOR. I feel that such a formal definition, perhaps produced under the auspices of the I A R U, would be a considerable help to maintaining consistent standards of equipment design. There are sufficient differences between AMTOR as currently practiced, and CCIR 476, that the AMTOR specification would not be a straight copy. (definition of amateur SELCAL coding, deletion of WRU and SELFEC, addition of "listen mode", to name the most significant). I enclose a draft of what I regard as my own definition of AMTOR. This was written before CCIR 476-4, but includes the resolution of ambiguities within 476-3 which I see now have been covered (in the same way) in 476-4.

The second question is more difficult to answer since it involves prediction. CCIR625 offers, in addition to the functions defined in 476, the ability to use 7 letters in the SELCAL code, and an elaborate system of self- authentication of the calling station. While 7-letter selcals are an improvement over 4-letters in the present system, the two are not compatable, in that a 476 unit cannot call a 625 unit. This is not a problem in the non-amateur invironment where out-stations rarely call out-stations, but will be a problem in the amateur environment until all old units are dead. I cannot see that the self-authentication feature of CCIR 625 has application in amateur radio. We are never likely to want to sell QSO's over the air! Both these extra facilities are achieved at some cost, namely in a doubling of the time required to synchronise the link, and resynchronise in the event of an interruption.

I can summarise my comments as follows:

(a) On the face of it, there is no need for any change to the rules, since, as they are presently worded, there is nothing to prevent existing AMTOR activity or inhibit future developement, including CCIR 625.

(b) If it is considered that AMTOR needs to be more tightly defined than by a vague reference to "code, baud rate, and emission timing", then perhaps consideration should be given to a formal definition of AMTOR, based on CCIR specifications and current amateur practice, in a similar way to that in which AX25 has developed from X25. Then maybe the rules should be changed to refer to this formal AMTOR specification.

(c) My own opinion is that CCIR 625 does not have enough to offer the amateur radio field as to warrant any change which would encourage it's adoption at the expense of existing AMTOR.

I hope these comments are useful to you in your meeting of May 23rd, and I would be most interested to hear of the outcome.

seventythree

Peter Martinez

J Peter Martinez G3PLX

Enclosure: draft AMTOR specification.

Notes to table 1

1. A represents start polarity, Z represents stop polarity.
2. B represents the higher emitted frequency and Y the lower.
3. Some figure-case characters (e.g. F, G, and H) may be assigned other meanings.
4. The 7-unit signals are transmitted with the left-most element of the codes shown in Table 1 first.

2.3 Service information signals.

These signals are used to control the procedures taking place over the radio circuit and do not form part of the transmitted messages. Service information signals are not normally printed or displayed. Table 2 lists the service information signals which may be used.

Table 2

Mode A (ARQ)	Transmitted signal	Mode B (FEC)
Control signal 1 (CS1)	BYBYYBB	
Control signal 2 (CS2)	YBYBYBB	
Control signal 3 (CS3)	BYYBBYB	
Idle signal beta	BBYYBBY	
Idle signal alpha	BBBBYYY	Phasing signal 1
Signal repetition (RQ)	YBBYYBB	Phasing signal 2

3. Characteristics Mode A (ARQ)

3.1 General

The system operates in a synchronous mode transmitting blocks of three signals from an Information Sending Station (ISS) towards an Information Receiving Station (IRS). A control signal is transmitted from the IRS to the ISS after reception of each block indicating correct reception or requesting retransmission of the block. These stations can interchange their functions.

3.2 Master and slave arrangements.

3.2.1 The station that initiates the establishment of the radio circuit (the calling station) becomes the "master" station, and the station being called becomes the "slave" station. This situation remains unchanged during the entire time that the established radio circuit is maintained, regardless of which station, at any given time, is the ISS or IRS.

3.2.2 The clock in the master station controls the timing of the entire circuit. This clock should have an accuracy of 30 parts per million or better.

3.2.3 The basic timing cycle is 450mS and consists for each station of a transmission period followed by a transmission pause during which reception is effected.

3.2.4 The master station transmit timing is controlled by the clock in the master station.

3.2.5 The clock controlling the timing of the slave station is phase-locked to the signal being received from the master station. The time interval between the end of the received signal at the slave station and the start of the transmitted signal from the slave station is constant.

3.2.6 The master station receive timing is phase-locked to the signal received from the slave station.

Note: The master station must accomodate variations in the time interval between the end of the transmitted signal from the master, and the beginning of the received signal from the slave, of between Ø and 170mS.

3.3 The information Sending Station (ISS)

3.3.1 The ISS groups the information to be transmitted into blocks of three traffic information signals (3x7 signal elements).

3.3.2 The ISS sends a block in 210mS (3x7 mS) after which a transmission pause of 240mS becomes effective.

3.4 The Information Receiving Station (IRS)

3.4.1 After the reception of each block, the IRS sends one control signal of 70mS duration (7 signal elements), after which a transmission pause of 380 mS becomes effective.

3.4.2 A master IRS sends the control signal at the same time in the 450 mS cycle as the third traffic information signal in the master ISS traffic information block. A slave IRS sends the control signal at the same time in the 450mS cycle as the first traffic information character in the slave ISS traffic information block.

3.5 Phasing procedure

3.5.1 When no circuit is established, both stations are in the "standby" condition. In this condition, neither of the stations is designated master, slave, ISS or IRS.

Note: If, in the "standby" condition, a station receives 4 consecutive alternating Mode B (FEC) "phasing signals", it commences operation in accordance with paragraph 4.4.3

3.5.2 The "call signal" contains four identification signals. Identification signals are selected from traffic information signals Nos. 1 to 26 (letters A-Z) as listed in Table 1.

3.5.3 The "call signal" consists of two traffic information blocks, containing:

-in "call block 1", in the first, second and third character positions respectively: the first identification signal, the service information signal "signal repetition", and the second identification signal.

-in "call block 2", in the first, second and third character positions respectively: the third identificaion signal, the fourth identification signal, and the "signal repetition".

3.5.4 The station required to establish the circuit becomes the master station and sends the "call signal", consisting of alternate "call block 1" and "call block 2" until it receives two consecutive identical "control signals 1", "control signals 2", or "control signals 3".

3.5.5 A station in the "standby" condition which receives a "call signal" in which the four identification signals correspond to the identity of the station, changes to the IRS condition and commences operation as described in paragraph 3.6.4.

3.5.6 On receipt of two consecutive identical "control signals 1" or "control signals 2", the calling station changes to the ISS condition and proceeds with the transmission of traffic information as described in paragraph 3.6.7.

3.5.7 On receipt of two consecutive identical "control signals 3", the calling station changes to the ISS condition and proceeds with the change-over procedure (paragraph 3.7.5 without sending any traffic.

3.6 Traffic flow

3.6.1 At all times after the start of traffic flow and until the station reverts to the "standby" condition, the station should retain the following information:

-whether it is in the master or the slave condition;
-whether it is in the ISS or IRS condition;
-whether the traffic flow is in the letter case or figure case condition;
-whether the current information block is "information block 1" or "information block 2".

3.6.2 The ISS transmits the traffic information in blocks, each block consisting of three signals. If necessary, "idle signals beta" are used to complete or to fill the information blocks when no traffic information is available for transmission.

3.6.3 The ISS retains the transmitted information block in memory until the appropriate control signal confirming correct reception by the IRS has been received.

3.6.4 For internal use, the IRS numbers the received information blocks alternately "information block 1" and "information block 2", starting with "information block 1" if the first transmitted control signal was "control signal 1", and starting with "information block 2" if the first control signal transmitted was "control signal 2".

Note: The choice of "control signal 1" or "control signal 2" for the first control signal sent by the IRS, is arbitrary. However, to maintain compatability with earlier equipments not functioning according to this specification, the first control signal sent in a second or subsequent period of IRS after the commencement of communication, should be "control signal 1" if the last control signal sent in the previous period of IRS was "control signal 2", and vice versa.

3.6.5 The IRS subsequently sends "control signal 1" at the reception of either:
-an unmutilated "information block 2"; or
-a mutilated "information block 1"; or
-an "information block 1" containing at least one "signal repetition".

3.6.6 The IRS subsequently sends "control signal 2" at the reception of either:
-an unmutilated "information block 1"; or
-a mutilated "information block 2"; or

-an "information block 2" containing at least one "signal repetition".

3.6.7 For internal use, the ISS numbers successive information blocks alternately "information block 1" and "information block 2". The first block should be numbered "information block 1" if the first control signal received is "control signal 1", and numbered "information block 2" if the first control signal received is "control signal 2". The numbering is stopped at the reception of a "control signal 3".

3.6.8 On reception of "control signal 1" the ISS sends "information block 1"

3.6.9 On reception of "control signal 2" the ISS sends "information block 2".

3.6.10 On reception of a mutilated control signal, the ISS sends a block containing three "signals repetition".

3.7 Change-over procedure

3.7.1 If the ISS is required to initiate a change in the direction of the traffic flow, the station sends the traffic sequence "figureshift" (No. 30), "+" (No.26), "?" (No.2), followed, if necessary, by one or more "idle signals beta" to complete the information block.

3.7.2 On receipt of the block which contains the "?" of the sequence "+?" (No. 26 and No. 2) with the traffic flow in the figure-case condition, or after the receipt of one more additional block, the IRS sends a "control signal 3". The presence of "idle signals beta" between the "+" and the "?" should not inhibit the response of the IRS. If the IRS response occurs after the additional block, then the contents of this block, whether mutilated or not, may be ignored by the IRS.

3.7.3 If the IRS is required to initiate the change in direction of the traffic flow, it sends a "control signal 3" immediately following the receipt of an unmutilated traffic block.

3.7.4 In either of the two cases described in 3.7.2 and 3.7.3, the IRS will, if required, repeat the transmission of a "control signal 3", until it receives a block containing "idle signal beta", "idle signal alpha", "idle signal beta".

3.7.5 On receipt of "control signal 3" the ISS sends a block containing "idle signal beta", "idle signal alpha", "idle signal beta", repeating the transmission of this block if required until it has correctly received a control signal consisting of a "signal repetition".

3.7.6 On receipt of the block containing "idle signal beta", "idle signal alpha", "idle signal beta", the IRS sends either:

-an information block containing three "signals repetition" if it is the slave station, or
-a control signal consisting of a "signal repetition" if it is the master.

It then changes to ISS and functions as described in paragraph 3.6.7.

3.7.7 The ISS changes to IRS after the receipt of a control signal consisting of a "signal repetition", and then functions as described in paragraph 3.6.4.

3.8 Time-out procedure

3.8.1 When reception of information blocks or control signals is continuously mutilated, both stations revert to the "rephase" condition after 32 cycles of continuous repetition, in accordance with paragraph 3.10.

3.9 End-of-communication procedure

3.9.1 If the ISS is required to terminate the established circuit, it sends the "end-of-communication block" containing three "idle signals alpha", until a "control signal 1" or "control signal 2" is received which indicates correct reception of that block by the IRS, following which the station reverts to the "standby" condition. However, the number of transmissions of the "end-of-communication block" is limited to four, after which the ISS reverts to the "standby" condition.

3.9.2 On unmutilated reception of the "end-of-communication block", the IRS sends the appropriate control signal, and reverts to the standby condition.

3.9.3 If the IRS is required to terminate the established circuit, it has first to change over to the ISS condition in accordance with paragraph 3.7 before the termination can take place in accordance with this paragraph.

3.10 Rephasing procedure

3.10.1 If during the traffic flow, reception of information blocks or control signals is continuously mutilated, both stations change to the "rephase" condition after 32 cycles of continuous repetition. Rephasing is the automatic re-establishment of the previous circuit immediately following interruption of that circuit as a result of continuous repetition (see paragraph 3.8)

3.10.2 After changing to the "rephase" condition, the master station immediately initiates the rephasing procedure. This procedure is the same as the phasing procedure, with the following differences:

3.10.3 If, at the time of the interruption, the slave station was in the IRS condition, it sends either:
-"control signal 1" if the last correctly received block before the interruption was "information block 2"; or
-"control signal 2" if the last correctly received block before the interruption was "information block 1".

3.10.4 If, at the time of the interruption, the slave station was in the ISS condition, it sends "control signal 3", to change over to the ISS condition in accordance with paragraph 3.7.2. When the change-over is completed, the master station sends either:
-"control signal 1" if the last correctly received block before the interruption was "information block 2"; or
-"control signal 2" if the last correctly received block before the interruption was "information block 1".

4. Characteristics Mode B (FEC)

4.1 General
The system operates in a synchronous mode, transmitting an uninterrupted stream of signals from a sending station to one or more receiving stations.

4.2 The sending station sends each signal twice, the first transmission (DX) of a specific signal is followed by the transmission of four other signals, after which the retransmission (RX) of the first signal takes place,

allowing for time-diversity reception at 280mS (4x70mS) time spacing.

4.3 The receiving station checks both signals (DX and RX) and uses the unmutilated one. When both signals appear as unmutilated but different, then both should be considered as mutilated.

4.4 Phasing procedure

4.4.1 When no circuit is established, all stations are in the "standby" condition and no sending or receiving condition is assigned to any station.

Note: If any station in the "standby" condition, receives an appropriate mode A (ARQ) "call signal", that station commences operation in mode A (ARQ) in accordance with paragraph 3.5.5.

4.4.2 The station required to transmit information becomes the sending station and sends alternately "phasing signal 2" and "phasing signal 1", whereby "phasing signal 2" identifies the DX position and "phasing signal 1" identifies the RX position. At least 10 of these phasing signal pairs should be transmitted before the station starts to send traffic signals.

4.4.3 On receipt of 4 consecutive alternating phasing signals, a station in the "standby" condition changes to the receiving condition.

4.5 Traffic flow

4.5.1 A sending station sends, during breaks in the information flow, "phasing signals 1" and "phasing signals 2" in the RX and DX positions respectively. At least one sequence of four consecutive phasing signal pairs should be inserted into the traffic stream for every 100 traffic signals sent.

4.5.2 The receiving station checks both signals received in the DX and RX positions,

- printing an unmutilated DX or RX signal; or
- printing a space (No. 31) or a user-defined "error character" if both DX and RX signals are mutilated, or appear unmutilated but different.

Note: the term "printing" is used in paragraph 4.5.2 to denote the transfer of traffic signals to the output device.

4.5.3 A receiving station reverts to the "standby" condition if, during a predetermined time, the percentage of mutilated signals received has reached a predetermined value.

4.6 End-of-transmission

4.6.1 A sending station should terminate the transmission by sending at least 1 second of consecutive "idle signals alpha" immediately after the last transmitted traffic information signal, after which the station reverts to the "standby" condition.

4.6.2 The receiving station reverts to the "standby" condition not less than 210mS after the receipt of two consecutive "idle signals alpha" in the DX position.

J.P Martinez G3PLX 22 Apr 1984

THE AMERICAN RADIO RELAY LEAGUE, INC.
INTERNATIONAL SECRETARIAT OF THE INTERNATIONAL AMATEUR RADIO UNION
ADMINISTRATIVE HEADQUARTERS NEWINGTON, CONNECTICUT, U. S. A. 06111

May 14, 1987

HF PACKET MESSAGE FORWARDING STATIONS

Gentlemen:

On Saturday, April 25, at Dayton, Paul Rinaldo and I met with David Toth, VE3GYQ, who stated that he was just elected net manager of the 14.109 group at a meeting of about nine held that previous evening. He indicated that he was speaking for the entire group of stations listed in Enclosure A.

He stated the following positions:

a. Stations want to use only their own call signs, not SSIDs of a teleport "club" call.

b. All stations listed in the 14.109 and 14.1115 columns of Enclosure A must be included in the STA.

c. Both 14.109 and 14.1115 must be used to accommodate the number of stations. There is no desire to change to lower frequencies as propagation changes. Frequencies in the 80-, 40- and 30-meter bands are not wanted.

d. There is no need for permission in the STA to operate at 1200 bauds.

e. All letters of participation must be sent to Toth for consolidation, not to the ARRL. Thus, if ARRL does not agree with the foregoing, the group will ask a consortium of TAPR, AMSAT and AMRAD to sponsor the STA.

Over the past two weeks, we have reviewed the points made by Toth and in subsequent contact with individual stations.

a. It seems that the main sticking point is the matter of how many stations are to be part of the STA request and whether or not they are to use their own call signs (rather than a "club call" with different SSIDs). Accordingly, we are prepared to drop the club/SSID approach and agree that each station is to use its own call sign.

b. We have no objection to any particular station being part of the STA request, including all the U.S. stations listed in the 14.109 and 14.1115 columns of Enclosure A. However, in order for stations to be part of the STA, each individual station must return to us a signed letter of participation.

c. The use of two frequencies in the 20-meter band (14.109 and 14.1115 MHz) would cause us problems because the ARRL Executive Committee and the International Amateur Radio Union have agreed that only one frequency should be used per band, outside the regular RTTY bands, for packet traffic. These agreements are not binding for all time, however, and may be reviewed in future. Here are some considerations:

(1) The frequencies just above 14.100, while virtually unused in the United States until recently for packet, are other country's phone bands. Foreign hams look on the 14.100-14.150 subband as a refuge where they can communicate in their own languages without stateside/English-language QRM. The "foreign phone" subband was cut in half by U.S. phone expansion just a couple of years ago. There is no doubt that further encroachment of packet into this foreign phone preserve will draw fire from our sister societies.

(2) Staying on a particular frequency, more or less continuously, is in itself quite controversial with many hams and with the FCC. The general practice in the HF bands is to use a frequency for the duration of a contact (or net session), then release it for others to use. "All day, every day" nets are in bad odor with the FCC and with many hams. There is some appreciation that packet message-forwarding stations essentially require the use of fixed frequencies because of the automatic nature of the operation. By using one frequency in a given band (particularly 20 meters), the packet message-forwarding stations have their camel's nose in the proverbial tent.

(3) Remaining on a frequency/band when propagation is poor between the two points of communication is incompatible with good spectrum management. Not only do the two stations in communication have poor reliability, but other stations for whom the frequency is optimum receive QRM from excessive retries. In other words, we should use 14 MHz when that frequency is right for us and at other times, such as at night, shift to a frequency that is closer to optimum for the net. That leaves 14 MHz for stations in other parts of the world to use when we're not. (Some stations already have been moving to 7 MHz when the 14-MHz band goes out; this is good, and should be encouraged and expanded.) We believe that the net should move according to propagation. This does not necessarily mean that all stations need to change in lock step or even change automatically. Neither does this mean that a particular station

must change frequency if that's awkward. The bottom line is that changing net frequencies with propagation is good for the net and good for other users; not changing is not defensible on spectrum-management grounds, even leaving aside for the moment the question of maximizing throughput.

(4) There is no propagational need to use 14 MHz for all distances during the daytime when there are frequencies available in the 10-MHz band. Some years ago, a number of people started out in this band with good results. Some stations are not as well equipped for 10 MHz as they are 14. It would seem that after sorting out capabilities, some stations could be on 14 MHz, others on 10 MHz, and still others on 7 MHz during the day. At night, 14 MHz can be discontinued, and 3.6 MHz used.

(5) There has been some discussion that these lower bands (3.6 and 7) are not suitable for packet, particularly at speeds higher than 300 bauds. It depends upon distance and where the MUF is, which relates to time of day. These bands are optimum for certain distances and times. As indicated earlier, ARRL HQ has the IONCAP propagation predictions to support this.

d. The issue of permission for 1200-baud operation is coming up rather late considering that we polled all interested HF packet stations who were unanimous on that. Of course, it depends upon the availability of modems, and not all stations have them. The feedback we have received was not in favor of accepting Kantronics' offer. However, stations having WorldChip modems have the capability of running V.23 (800-Hz shift FSK). Modems of other designs may be tweaked to 800-Hz shift, and we'll be happy to assist by having the ARRL lab look into mods. We believe 1200 bauds is worth a try but are willing to postpone this for a later STA if the period of this STA is kept short (Toth indicated that three months was fine, but we think six months is more realistic). By the way, 1200-baud operation is already used successfully outside FCC jurisdiction, on 80 meters, of all places.

e. It seems an unnecessary step to send letters of participation via VE3GYQ, as that will delay the filing of the STA request. ARRL HQ has 26 in hand now. We welcome the others.

We regret any disharmony associated with this proposed STA. The purpose of the STA was and is to develop the data needed to support rules changes so that a high-quality HF packet automatic message-forwarding network can operate legally, as soon as possible. Our intent is to file an STA request with the FCC as soon as we can get the letters of participation from those wishing to be part thereof.

Are you willing to go along with this game plan? If so:

o If you haven't sent us your letter of participation, please fill in the one enclosed and return it in the business reply envelope provided. (Please postmark your reply by May 26.)

o If you have already sent us your letter of participation, you don't have to do any more.

Sincerely,

David Sumner

David Sumner, K1ZZ
Executive Vice President

Enclosures

A. VE3GYQ station/frequency list

(For those U.S. stations which have not sent us a letter of participation):

B. Letter of participation
C. Business reply envelope

ENCLOSURE A

REVISED: 87-04-23

The following is the assignment of frequencies and forward times with an attempt to show inter-frequency links that run on VHF/UHF.

14.109 MHZ			14.1115 MHZ			14.107 MHZ			7.093 MHZ		
STATION	FWD		STATION	FWD		STATION	FWD		STATION	FWD	
N1DL	45	<-->	W2HPM	??							
WB7DCH	54	<-->	KE7OM	??							
W1HAB	40	<-!>	KOHOA	??							
KC0OJ	??	<-!									
WA1DSW	38	<-->	WA1WLV-1	??							
WB6KAJ	35	<-->	KD6SQ	??	<---------------------			--->	WA6DDG-1	39	<-!
WORLI	13	<-->	N4CHV	35	<-->	KB6IRS	??	<-->	KE6BX	45	<-!
W5XO	20		WA5QZI	09	<-->	WA4EWV	??				
W9ZRX	25	<-->	N4XI	40							
W3IWI	56	<-->	K8MMO	33							
KOKBY	15	<-->	K4TKU-1	00							
KR5S	00	<-->	K7PYK	??	<-->	KE7CZ	??				
WD9DHI	52	<??>	W9ZBD-1	17	<??>	WB9OWN	??				
AD81	46	<-->	WA1LRL	??							
VE3GYQ	07	<-->	NA2B	10	<-->	VE3NUU	??				
N0AN	18	<-->	WA0CQG	47							
WA5DVV	35		WD5B	31							
KN5D	03		WB9TPG	49		KH6WY	??	<-->	WH6I	??	
WA4SZK	22		K4EID	??		KL7GNG	??				
VE4AFO	42		AG3F	??		KL7CG-1	??				
KC2TN	10					VK4BBS	??				
VE7TOM	31										

NOTE: Please check to make sure that your forward time has or has not been changed ... if it has been, in most cases it was a small change ... if a change presents you with a REAL problem, please advise me.
Please enable all of the BBSs listed as a BBS in your user file, whether on your freq or not ... in return, please stay on your assigned freq 24 hr/day, 7 days/wk, in order to make this work.

73, and thank you for your assistance and support,
Dave VE3GYQ, NCS

LETTER OF PARTICIPATION

Date:____________, 1987

Mr. Michael T. N. Fitch, Chief
Private Radio Bureau
Federal Communications Commission
Washington, DC 20554

Dear Mr. Fitch:

This is to request that Amateur Radio station ________ be part of the American Radio Relay League's request for special temporary authority for unattended operation under automatic control of HF packet-radio stations.

Sincerely,

Signature________________________

Name____________________________

Mailing Address:

____

____

____

Fixed Station Operation Location:

____

____

____

Daytime Phone Number:

____

Night Phone Number:

____

Post Office Box 205
Holmdel, NJ 07733
201-671-8107 [R]
201-834-1149 [B]
April 30, 1987

Mr. Paul Rinaldo, W4RI
Chairman, ARRL Ad Hoc Committee
on Digital Communications
American Radio Relay League
225 Main Street
Newington, CT 06111

Dear Paul:

Enclosed is a document that I would like to submit to the Digital Committee for its consideration. If the document is of interest, I would ask that the Committee circulate it among vendors for comments and then, after comments are included, consider the result for adoption as a recommendation or application note by the Digital Committee. The document provides an interface specification for interconnecting audio tone modulators and demodulators (modems) to HF Single-Side-Band (SSB) radios. I have taken it upon myself to write this document because of discussions during and after the Dayton 87 Hamvention RTTY forum. I have done so in hopes that most manufacturers will follow the final recommendations, to the extent they can where cost increases are minimal, to ensure compatibility between all equipment regardless of manufacturer.

At this point, the document is a draft of one person's opinion. I would like to solicit comments from others to improve its value. To ensure that comments are incorporated correctly into this document, I suggest that the people you distribute it to carefully mark up their copy to read exactly as they want it to and then return it to me at the address listed above. Without specific written comments, it is possible that suggestions may not be completely or correctly incorporated into the next revision of the document.

Thanks for your support and interest.

Sincerely,

Paul Newland, ad7i

Copy (w/encl) to:
Craig Martin, Trio-Kenwood

An Interface Specification for Interconnecting Single-Side-Band Radios to Audio Modulators and Demodulators

Paul Newland, ad7i
Post Office Box 205
Holmdel, New Jersey 07733
201-671-8107 [R]
201-834-1149 [B]

Abstract

This document provides an interface specification for interconnecting audio tone modulators and demodulators (modems) to HF Single-Side-Band (SSB) radios. The specifications contained in this document are, of course, non-binding on anyone. However, it is hoped that most manufacturers will follow the final recommendations, to the extent they can where cost increases are minimal, to ensure compatibility between all equipment regardless of manufacturer.

This document is a draft of one person's opinion. Comments are hereby solicited to be incorporated into the document to improve its value to the users of HF radio AFSK data communications. To ensure that your comments are incorporated correctly into this document, I suggest that you carefully mark up this copy to read exactly as you want it to and then return it to me at the address listed above. Without specific written comments, it is possible that your suggestions may not be completely or correctly incorporated into the next revision of the document.

In general, the approach of large amplitude signals on low impedance lines is used to mitigate Radio Frequency Interference (RFI) problems. A nominal impedance of 600Ω was chosen as its is commonly used for wire transmission systems and the VSWR is less then 1.2:1 when driving older 500Ω lines. RCA jacks and plugs are recommended on both the modem and the radio as they are commonly available and easily lend themselves to constructing shielded cables.

An Interface Specification for Interconnecting Single-Side-Band Radios to Audio Modulators and Demodulators

CONTENTS

An Interface Specification for Interconnecting Single-Side-Band Radios to Audio Modulators and Demodulators

Paul Newland, ad7i
Post Office Box 205
Holmdel, New Jersey 07733
201-671-8107 [R]
201-834-1149 [B]

1. Purpose

This document provides an interface specification for interconnecting audio tone modulators and demodulators (modems) to HF Single-Side-Band (SSB) radios. It is the result of some discussions that took place during and after the 1987 Dayton Hamvention RTTY forum. It is my hope that the document can be submitted to the ARRL Digital Committee for publication as a recommendation or application note to help guide manufacturers and home-brewers of RTTY equipment. This document is a draft and in no way necessarily represents the views or opinions of anyone other than myself.

1.1 Providing Comments

Comments on this document are solicited and encouraged. To ensure that your comments are incorporated correctly into this document, I suggest that you carefully mark up this copy to read exactly as you want it to and then return it to me at the address listed above. Without specific written comments, it is possible that your suggestions may not be completely or correctly incorporated into the next revision of the document.

1.2 Approach

In general, the approach of large amplitude signals on low impedance lines is used to mitigate Radio Frequency Interference (RFI) problems. A nominal impedance of 600Ω was chosen as its is commonly

used for wire transmission systems and the VSWR is less then 1.2:1 when driving older 500Ω lines. RCA jacks and plugs are recommended on both the modem and the radio as they are commonly available and easily lend themselves to constructing shielded cables.

1.3 Non-binding Obligation

The specifications contained in this document are, of course, non-binding on anyone. However, it is hoped that most manufacturers will follow the final recommendations, to the extent they can where cost increases are minimal. Doing so should ensure equipment compatibility between different manufacturers.

1.4 Companion Proposals

One additional paper has been completed and another is in the works that cover other topics involving HF data communications. The first paper describes the measurement of TX/RX switching times. The switching time test procedure was documented on pages 8 and 9 in the March 1987 issue of *QEX* in the article "How to Measure Transceiver TR Switching Times" by Paul Newland, ad7i. The second paper, which is in the works, discusses the importance of independent selection of filters, AGC characteristics, USB/LSB, etc., for radios.

2. Definition of Terms

Different terms are applied to different functions within the data communications system. This section defines some of the terms to help ensure that all users are viewing this document from a common vantage point.

Receiver — A receiver is a device that detects signals that travel on RF carriers and converts these RF signals to IF or AF signals that are then made available to other systems.

Transmitter — A transmitter is a device that changes (or modulates) a RF carrier in a prescribed manner based on an input AF or IF signal.

Transceiver — A transceiver is a device that contains both a receiver, transmitter and a device to control antenna switching between the two.

Modulator — A modulator is a tone (possibly multiple simultaneous tone) generator whose amplitude, phase, and/or frequency is changed based on a digital data input signal.

Demodulator — A demodulator is a device that detects AF tone signals and converts them to data signals for a computer or other digital device to handle.

Modem — A modem is a device that contains the functions of both the modulator and demodulator.

3. Audio Measurements

The audio measurements called for in this document are done with a scope rather than a RMS voltmeter to avoid problems when using complex waveforms or multi-tone systems. Additionally, a discussion of open circuit versus terminated circuit voltages is provided. It is meant as a tutorial; most readers can skip it.

3.1 Open Circuit versus Terminated Circuit

Sometimes people get confused when they measure output voltages of line drivers. The discrepancy usually involves the use – or lack of use – of a termination. The difference leads to a doubling or halving of the expected voltage (6 dB). Double termination usually leads to a 30% drop in voltage (or 3 dB change). The equivalent circuit for the interconnection of the audio output of a SSB radio to the input of a demodulator is shown in Figure 1. The voltage output of the radio can be modeled as a voltage source that can supply infinite current in series with a resistor that represents the output impedance. Another resistor of the same value is assumed to represent the input to the demodulator. These two resistors set the impedance of the circuit *and act as a 2:1 voltage divider.* Thus, the voltage delivered to the demodulator is half that provided by the perfect voltage source within the radio. If the radio's output impedance goes to a small value (less than 60Ω) the voltage divider effect has been

removed and almost the full value of the perfect voltage source appears at the demodulator's input. This makes the radio's output voltage look like it doubled. It didn't, even though the voltage delivered to the demodulator did double.

Conversely, if the radio's output impedance remains at 600Ω and the demodulator's input impedance increases to a large value, (above 6 KΩ), then, again, the voltage divider has been distroyed and the voltage delivered to the demodulator has doubled.

In some cases it is helpful to run with mismatched impedances. However, in most installations, it's best if the source impedance matches the load impedance.

3.2 Voltage Amplitude Measurements

All audio output measurements should be made with a calibrated scope measuring across a 600Ω load resistor and reported as peak-to-peak (pp) voltages. Nominal signal level is 2.2 Vpp which, for a sine wave, is equivalent to 775 mVrms or 0 dBm when terminated in a 600Ω load. Avoid the use of RMS meters or conversions to RMS as it's the peak voltage that matters to a SSB radio (when flat-topping, for instance). A possible peak-to-peak adapter for a DC voltmeter is shown in Figure 2 for the benefit of home-brewers who may not have access to a scope.

4. Transmitter Control – TXON Circuit

The on/off control of the transmitter is done over the TXON circuit. The circuit consists of a power source and current sensor in the transmitter plus a current sink in the modulator. An example of a circuit that may be suitable for use as a TXON control and driver appears in Figure 3.

4.1 Connector

The connector for the TXON circuit on both the modulator and the transmitter shall be a coaxial RCA connector.

4.2 Transmitter TXON Sensor

The TXON circuit operates similar to most PTT circuits. However, it is modified to ensure that it doesn't present an inductive load to the driving circuit and that it isn't susceptible to RFI. The TXON circuit consists of a positive voltage source of less than 20 volts that is current limited to less than 50 mA (when connected to ground). At currents of less than 100 μA, the transmitter must remain OFF. At currents of more than 10 mA the transmitter must be ON.

4.3 Modulator TXON Driver

The modulator will provide a path to sink current from the transmitter's TXON circuit to ground when the modulator wants the transmitter to be activated. The maximum voltage of the transmitter's TXON circuit will be less than 20 volts DC. The maximum current of the transmitter's TXON circuit will be less than 50 mA when connected to ground. The transmitter's TXON circuit will not present a significant inductive reactance. A leakage current of less than 10 μA will ensure that the transmitter is off. Allowing at least 25 mA to flow from the transmitter's TXON circuit will ensure that the transmitter is on.

5. Radio Receiver Audio Output

This section describes the audio output circuit for the radio receiver. An example of a circuit that may be suitable for use as an audio output driver appears in Figure 4.

5.1 Connector

The connector for the radio receiver audio output shall be a coaxial RCA connector.

5.2 Impedance

The impedance, measured over the frequency range of 300 Hz to 5 KHz, shall be, nominally, 600Ω. The output circuit shall be blocked by a capacitor within the radio of at least 10 μF and suitable working voltage. Note that this means a DC ohm meter should measure infinite resistance between

this output and ground.

5.3 Amplitude

The amplitude of the signal at this output is NOT affected, in any way, by the front panel AF gain control. The nominal amplitude of this output signal shall be 2.2 Vpp (Volts peak-to-peak). The maximum amplitude of this output signal shall not exceed 4.4 Vpp; a limiter may be included within the receiver to ensure that larger levels are compressed or limited. When AGC is on, the minimum signal output amplitude shall be greater than 220 mVpp. These tests are made by connecting a CW signal generator to the receiver and varying the generator level from 1 μVrms (-107 dBm) to 225 mVrms (0 dBm) in 6 dB steps (or less) while noting the minimum and maximum audio output signal amplitudes. No manual adjustment of RF gain, IF gain, or attenuators is allowed during these tests.

5.4 Transient Voltages

Any transient voltage generated by the receiver, such as might be caused when going from a squelched condition to an unsquelched condition, shall be constrained to occur within the first 5 mS of the change in condition and shall have a zero-to-peak level no greater than 6 dB above the zero-to-peak voltage of the steady state amplitude of the nominal tone output.

6. Radio Transmitter Audio Input

This section describes the audio input circuit for the radio transmitter. An example of a circuit that may be suitable for use as an audio input conditioner appears in Figure 5.

6.1 Connector

The connector for the radio transmitter audio input shall be a coaxial RCA connector.

6.2 Impedance

The impedance, measured over the frequency range of 0 to 5 KHz, shall be, nominally, 600Ω. Note that this means a DC ohm meter should measure about 600Ω to ground on this input.

6.3 Amplitude

The nominal amplitude of this input signal shall be 2.2 Vpp (Volts peak-to-peak). The maximum amplitude of any input signal shall not exceed 8.8 Vpp (Volts peak-to-peak); a limiter may be included within the transmitter to ensure that larger levels are compressed or limited. The transmitter shall be capable of reaching full rated transmitter power with any input signal level greater than 200 mVpp, perhaps by adjusting the front panel microphone gain control to maximum.

7. Modulator Audio Output

This section describes the audio output circuit for the tone modulator. An example of a circuit that may be suitable for use as an audio output driver appears in Figure 4.

7.1 Connector

The connector for the radio receiver audio output shall be a coaxial RCA connector.

7.2 Impedance

The impedance, measured over the frequency range of 300 Hz to 5 KHz, shall be, nominally, 600Ω. The output circuit shall be blocked by a capacitor within the modulator of at least 10 μF and suitable working voltage. Note that this means a DC ohm meter should measure infinite resistance between this output and ground.

7.3 Amplitude

The nominal amplitude of this output signal shall be 2.2 Vpp (Volts peak-to-peak). A user adjustment may be provided to increase this signal to no greater than 4.4 Vpp or reduce this signal by any amount.

7.4 Muting

The tone output shall be reduced by at least 55 dB whenever the TXON circuit is de-energized. This feature may be disabled by the user, so that the tone output is always activated.

7.5 Transient Voltages

Any transient voltage generated by the modulator, such as might be caused when going from a tone off condition to a tone on condition, shall be constrained to occur within the first 5 mS of the change in condition and shall have a zero-to-peak level no greater than 6 dB above the zero-to-peak voltage of the steady state amplitude of the nominal tone output.

8. Demodulator Audio Input

This section describes the audio input circuit for the radio transmitter. An example of a circuit that may be suitable for use as an audio input conditioner appears in Figure 5.

8.1 Connector

The connector for the radio transmitter audio input shall be a coaxial RCA connector.

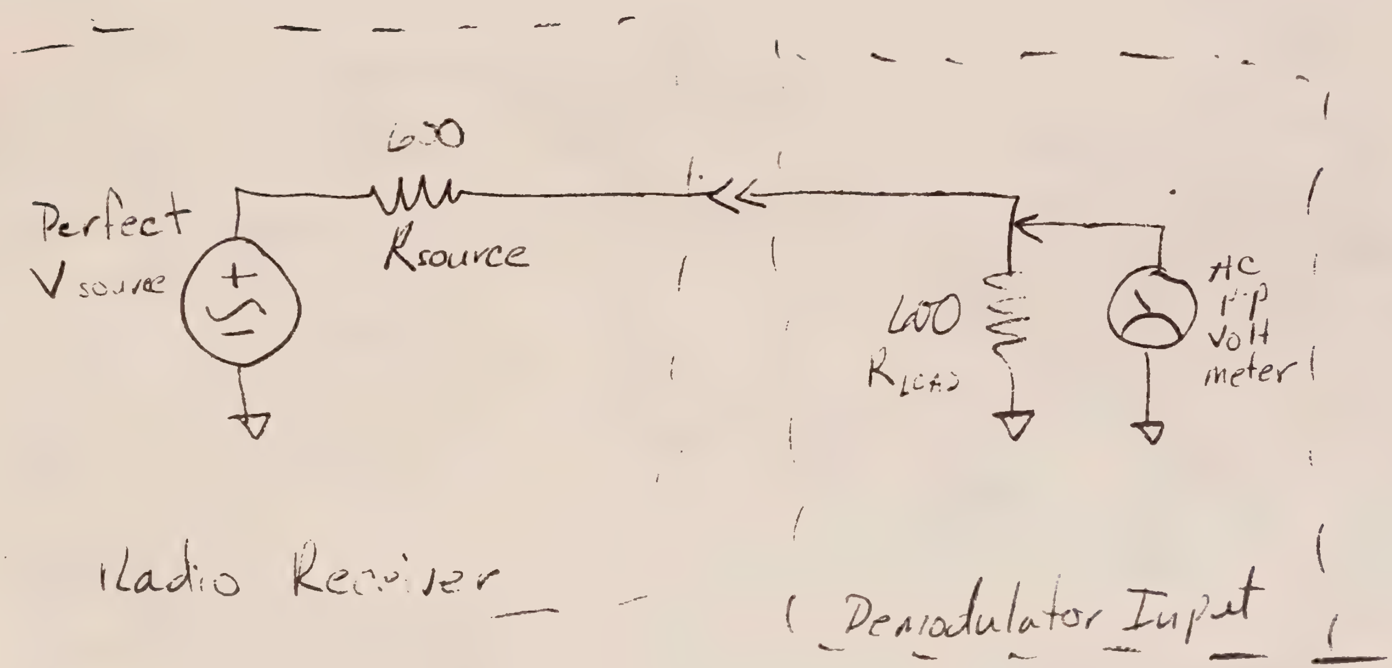
8.2 Impedance

The impedance, measured over the frequency range of 0 to 5 KHz, shall be, nominally, 600Ω. Note that this means a DC ohm meter should measure about 600Ω to ground on this input.

8.3 Amplitude

The nominal amplitude of this input signal shall be 2.2 Vpp (Volts peak-to-peak). The maximum amplitude of any input signal shall not exceed 8.8 Vpp; a limiter may be included within the demodulator to ensure that larger levels are compressed or limited. The demodulator shall be capable of detecting and using input signal amplitudes greater than 50 mVpp.

FIG 1
Model of circuit from
Rx to demod



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E-1612-A-1(3/84)

ISSUE

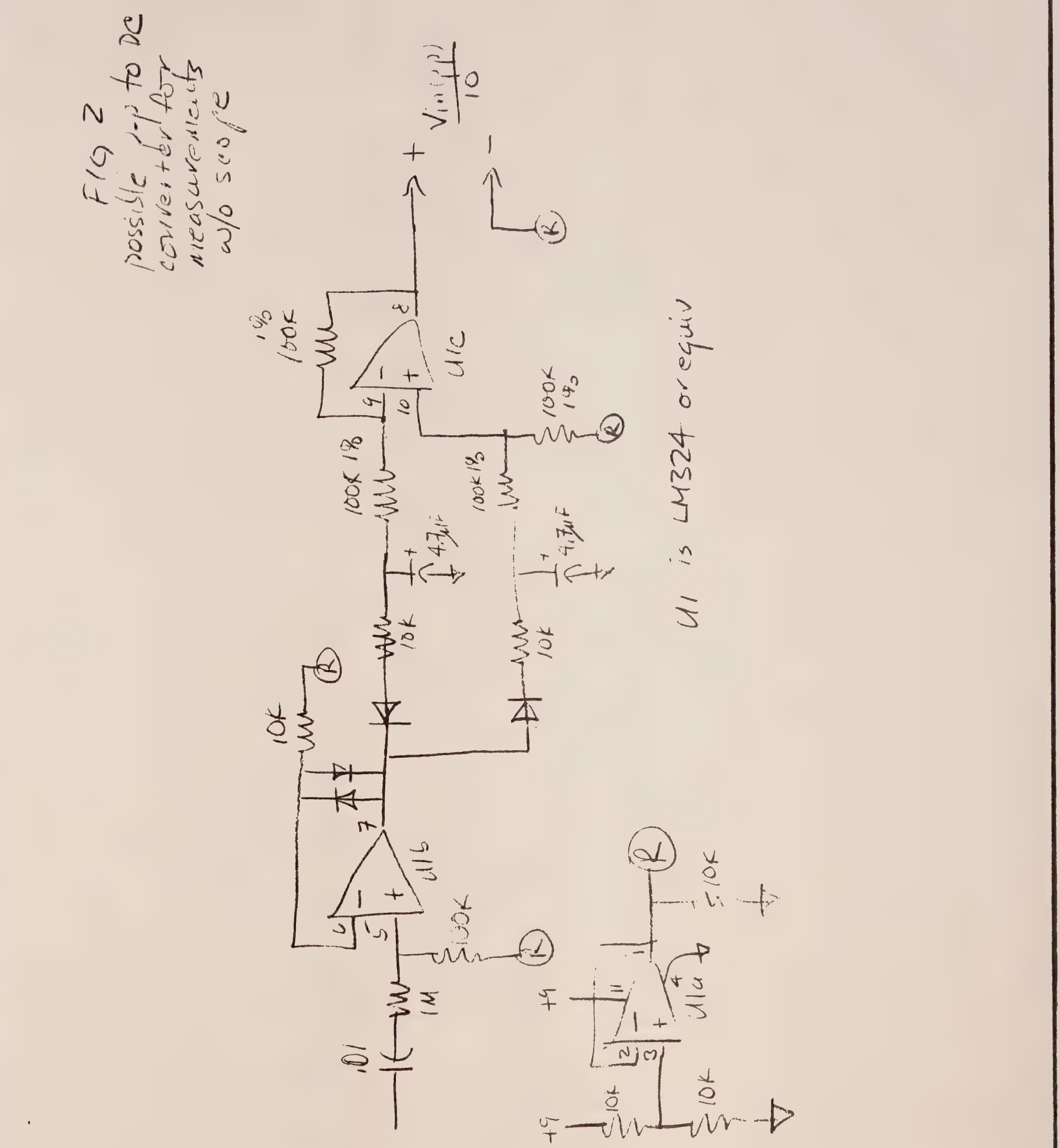
ISSUE	ENGR / DRAWN	TITLE		AT&T Bell Laboratories	SHEET
0	PKV / PKV	Model of circuit for Rx to demod	FIG 1	870428	
				NO. OF SHEETS PER SET	

7 11/16

10 5/8

7 11/16

10 5/8



ISSUE

ISSUE	ENGR	TITLE	AT&T Bell Laboratories
0	DRAWN	possible circuit for pp voltmeter FIG 2	870501 SHEET
			NO. OF SHEETS PER SET

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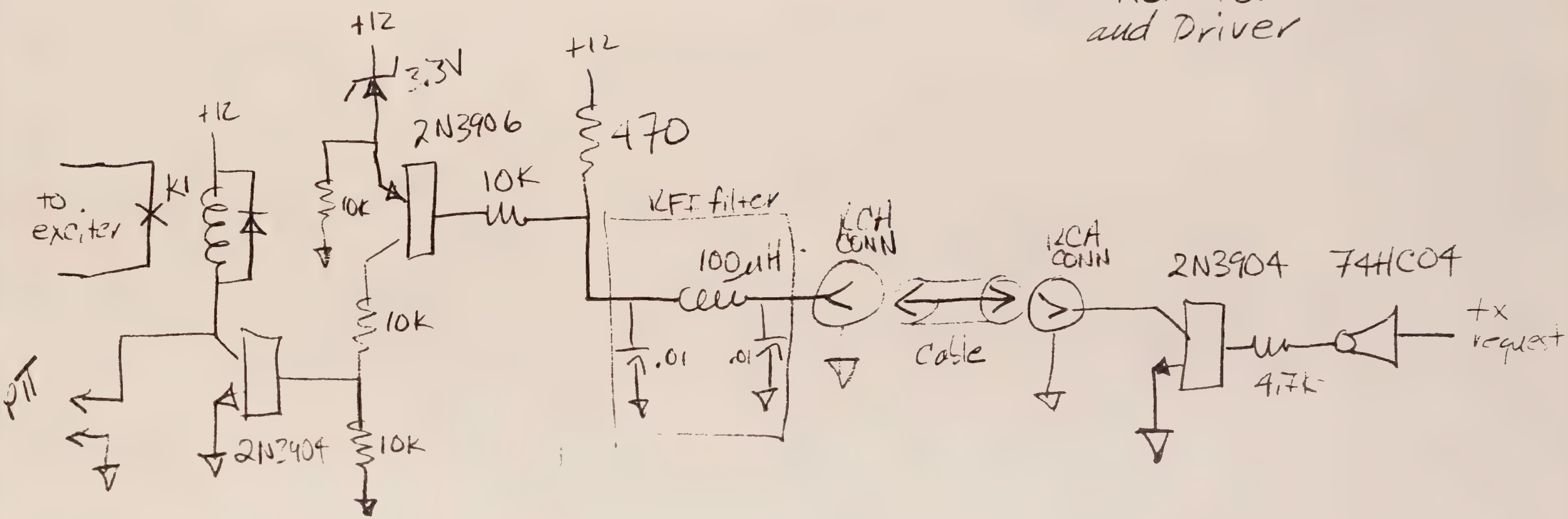
E-1612-A-1(3/84)

ISSUE

FIG 3

TXON Power Source and Driver

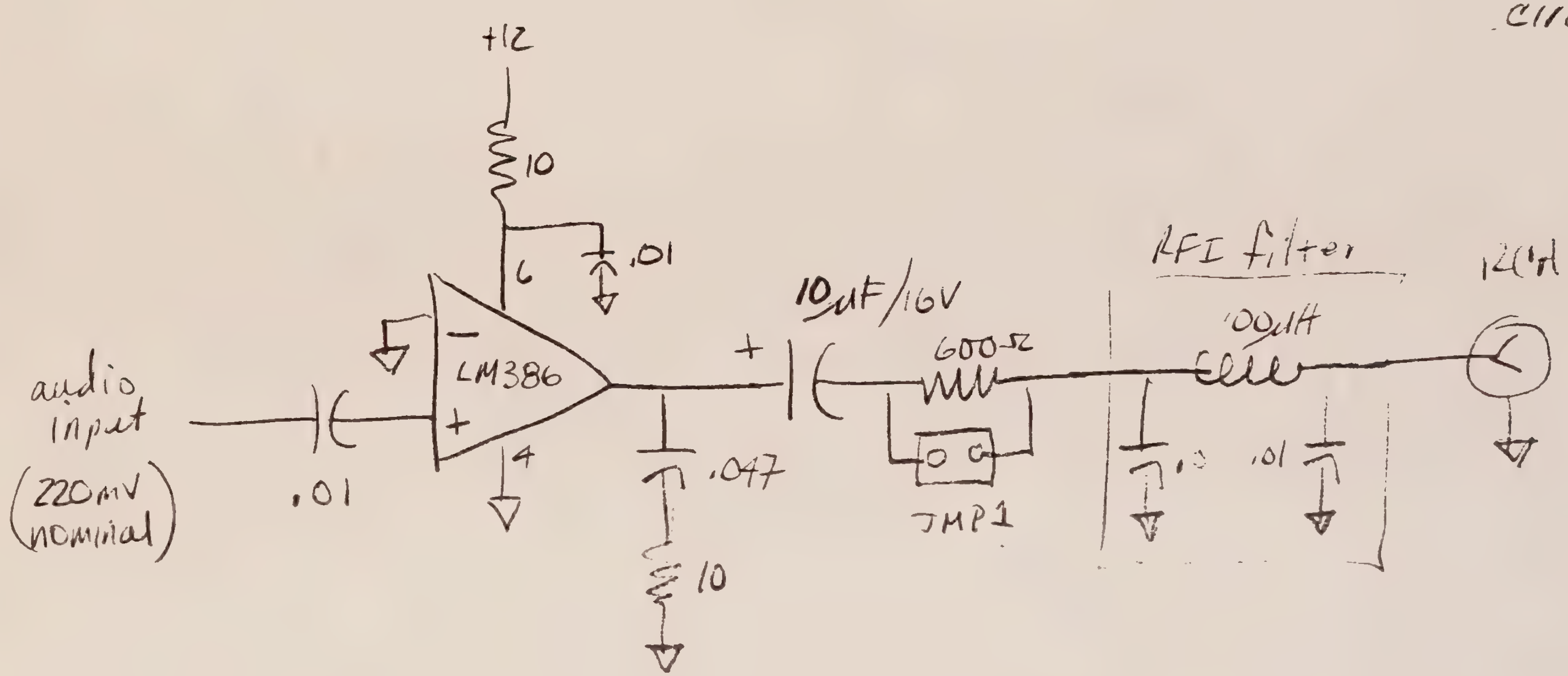


Transmitter TXON Power Source and sensor

Modulator TXON Driver

ISSUE	ENGR	TITLE	AT&T Bell Laboratories	
0	[illegible]	Possible TXON Power Source, sensor & driver circuits Fig 3	870428	SHEET
	DRAWN [illegible]		NO. OF SHEETS PER SET	

FIG 4
possible audio output
circuit



Notes 1) Install JMP1 for very low impedance output

2) Most op-amps can't drive a 600 load to 4.4 Vpp. Thats why an audio driver chip is recommended

3) The output impedance of the popular XR2206 is 600Ω and can have an open circuit voltage in excess of 4.4Vpp.

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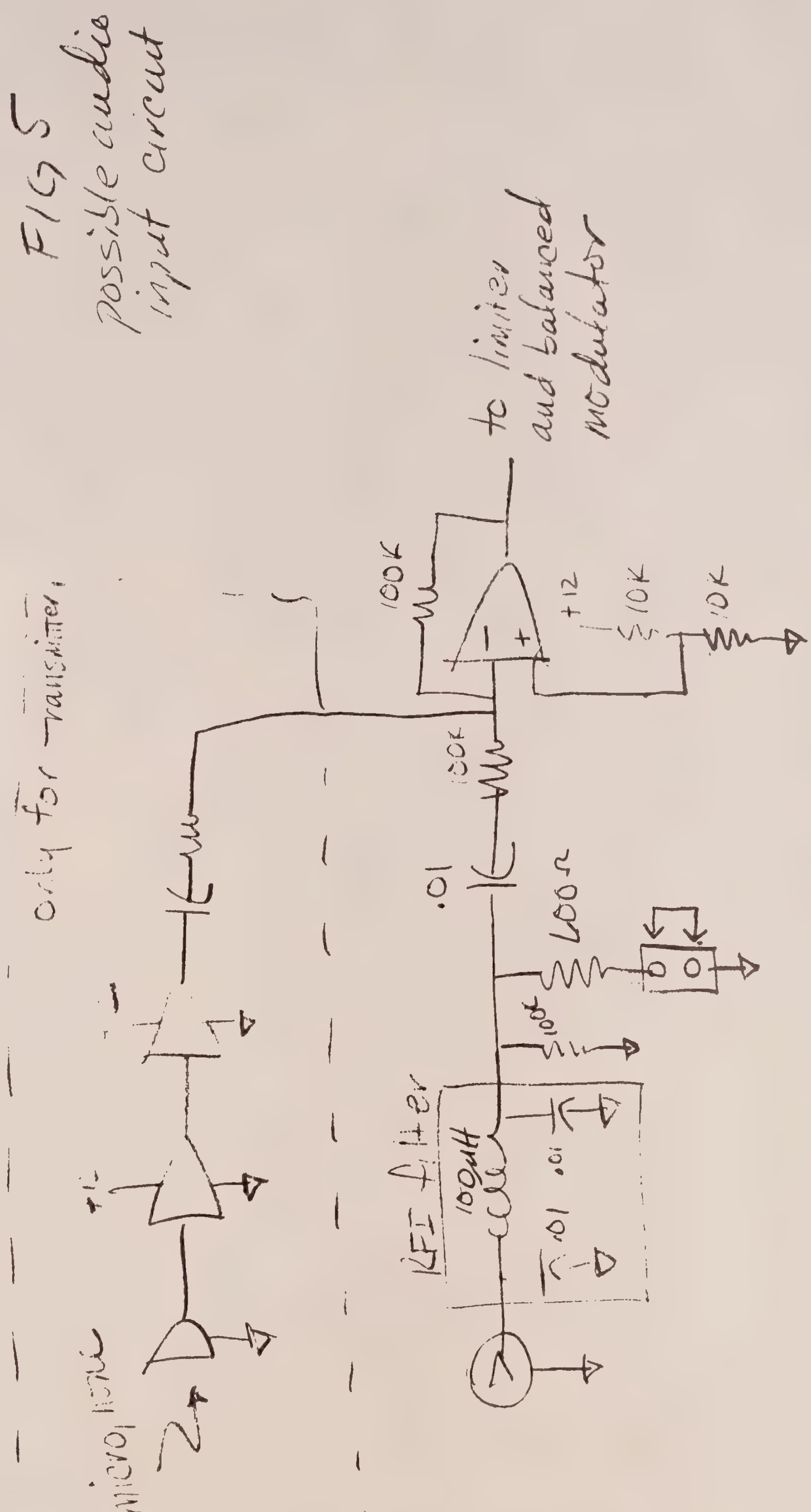
E-1812-A-1(3/84)
ISSUE 0
ENGR
DRAFT
TITLE possible audio output circuit FIG 4
AT&T Bell Laboratories
870428
NO. OF SHEETS PER SET
SHEET
ISSUE
10 5/8
7 11/16

7 11/16

10 5/8



ISSUE

ISSUE	ENGR	TITLE	AT&T Bell Laboratories	
0	DRAWN	Possible audio input circuit FIG 5	870428 NO. OF SHEETS PER SET	SHEET

PRINTED IN U.S.A. E-1612-A-1(3/84)

March 30, 1986

AD HOC COMMITTEE ON AMATEUR RADIO DIGITAL COMMUNICATION

Enclosed is a FAXed copy of the Notice of Proposed Rule Making in the matter of "Amendment of the Amateur Radio Service Rules to Expand the Privileges Available to Novice Operators," released by the FCC on April 30, 1986.

Committee members should take a close look at digital-communications aspects of the "Novice Enhancement" NPRM. If possible, please forward your comments in writing to me for circulation to the Committee as soon as possible. As comments must be filed by July 16, 1986, there will be time for discussion at the Digital Committee meeting scheduled for June 14-16 in Newington. I will be circulating a proposed agenda and other meeting details in the near future.

On another subject, Tomo Hayami, JA1NEZ, of CQ Publishing Co, Ltd, was kind enough to send us copies (one per Committee member) of the Autumn 85 issue of Ham Journal that featured packet radio. Please share this copy with other packeteers in your area as it signals strong packet interest developing in Japan.

73,

Dave

Paul L. Rinaldo, W4RI
Chairman

encl

THE AMERICAN RADIO RELAY LEAGUE, INC.
INTERNATIONAL SECRETARIAT OF THE INTERNATIONAL AMATEUR RADIO UNION
ADMINISTRATIVE HEADQUARTERS NEWINGTON, CONNECTICUT, U.S.A.

April 29, 1986

Truett Lee Smith, PhD, KD6YV
620 Iris Avenue, #131
Sunnyvale, CA 94086

Dear Truett:

Appreciate your letter on digital transmission of images.

We have copies of CCITT Recommendations T.4 and T.5, and NAPLPS. The Digital Committee will be considering their applicability to Amateur Radio as well as other ideas that might be put forward by amateurs.

I was particularly interested to learn that you are professionally involved in image compression and transmission. As the Committee gets a little deeper into this subject we will need some expert advice in certain areas -- I believe this is one.

AX.25 is related to X.25 as you surmised. As far as we've gone to date is to agree on Level 2. AX.25 is essentially LAPB with an address field that has been expanded to accommodate Amateur Radio call signs of the origin, destination and repeater stations. Yes, it uses CRC-16. I am enclosing a copy of the AX.25 specification for your information.

As for your question about whether the FCC rules prohibit transmission of music in digital form, we have discussed it with the Private Radio Bureau but don't have an interpretation for you at this time. About all I can say is that there appears to be some willingness to entertain some intelligent thought on the subject.

Can we count on you for some expert advice in the area of image compression and transmission? At this point, our study is just getting started, so we may not know the right questions yet.

73,

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communication

PLR/maty

PR

1986 APR 28 AM 10:51

23 April 1986

Chairman, Digital Committee
ARRL HQ
225 Main Street
Newington, CN 06111

Dear OM,

I noticed in QST that you are interested in input relative to techniques for the digital transmission of images. What follows are a few of my thoughts on the subject.

If you are interested in the transmission of binary images, then there already exists an international standard which is used in the facsimile industry. It is the CCITT Group 3/Group 4 facsimile standard given in CCITT recommendations T.4 and T.5. These standards assume that the image is being transmitted in the form of digital rather than analog data. This results in an average reduction in image data by a factor of 10 to 15. Sometimes more.

The Group 3 one-dimensional compression standard involves a Huffman encoding of the black and white pixel run-lengths using a standardized encoding tree. Such an encoding is fairly easy to implement in software, though hardware is faster but more expensive. The two-dimensional technique used in both Group 3 and Group 4 facsimile machines involves an encoding of the differences between successive lines. It results in higher compression ratios but is somewhat more complex to implement.

If it is desired to handle images which are not binary (i.e., not black or white pixels only) then several options are available: (1) the Metafile definition in the Graphic Kernel System or GKS which is currently implemented in the Virtual DEvice Interface supplied by Graphic Software Systems and IBM for many devices. This is an ANSI standard established by committee X3H33. (2) the NAPLPS standard which, though quite complicated, is still device independent. (3) the Videotext standard, which is also a bit complicated -- mainly due to the difficulty of encoding a given picture into its format; there may be questions about resolution, too, since it was designed to produce fairly low-quality graphics due to bandwidth limitations (note that the

term "videotext" applies to several different systems).

Please note that I have avoided device-dependent formats such as (1) MacPaint files, (2) IBM PC BASICA BSaved images, (3) video memory images from any display adapter for any personal computer. I believe strongly that device-independence should be in any standard adopted.

If you would like any further ideas from me or clarification of the above please feel free to contact me. Image compression and transmission is my business. The company I work for, Talus Corp., builds a document scanner which attaches to an IBM PC or compatible and stores the images in Group 3 one-dimensional compressed form. If other possibilities are to be considered, then the above suggestions would have to be expanded to include quadtree encodings, Fourier techniques (i.e., spatial frequence coding), adaptive Huffman compression of the image data as in the compression of binary files by the SQ program, etc.

One question -- what is AX.25? It is obviously related to X.25 but how? I admit to not keeping up on my reading but this one caught me by surprise, especially since the CCITT has apparently just chosen the Microcom Network Protocol (MNP) over X.PC as the standard asynchronous packetized data-link protocol for computers. Does AX.25 support multiple sessions like X.PC or not like MNP? Does it use CRC-16 as the error-detection polynomial? Where do I get a copy of the specification?

And while we are discussing digital stuff, consider the following little question -- does the FCC rule prohibiting transmission of music by an amateur station prohibit the transmission of a digital data stream either originated by or destined for a MIDI (Musical Instrument Digital Interface) device?

Most sincerely, 73,

Truett Lee Smith

Truett Lee Smith, Ph.D., KD6YV
620 Iris Ave., #131
Sunnyvale, California 94086

THE AMERICAN RADIO RELAY LEAGUE, INC.
INTERNATIONAL SECRETARIAT OF THE INTERNATIONAL AMATEUR RADIO UNION
ADMINISTRATIVE HEADQUARTERS NEWINGTON, CONNECTICUT, U. S. A. 06111

April 29, 1986

GLB Electronics, Inc.
151 Commerce Parkway
Buffalo, NY 14224

Dear Gil:

Enjoyed the chat at Dayton. You're working on some interesting projects.

Concerning your ideas on protocol indentifiers (PIDs), the Digital Committee can consider them at our June 14-16 meeting in Newington. Please send me something on paper by the end of May so I can make advance distribution to the committee.

73,

Paul

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communications

PLR/maty

April 11, 1986

DIRECTOR CAREY

Chairman, Membership Services Committee

Dear Lys:

Director Stafford's letter to you dated April 6 just arrived with the copy of the Michigan Packet Radio Frequency Plan as published in QEX. While I agree with Rod that this is orderly and logical, there are some other inputs that need to be considered.

I have been in communication with the Michigan packeteers on this issue. There are at least two camps there, and they're apparently not in agreement. In fact, they're having a shoot-out at high noon in Dayton, and I'm invited. If they are successful, it would seem that a single Michigan plan would emerge. If not, there may be at least two and perhaps as many as one more than the number of participants. By the way, it doesn't look like the Michigan plan took into account the Canadian allocations and should have done so because of their location.

The Michigan group, while perhaps the first to go public, is not the only one that has given this subject some serious thought. The only one that I have documented is one dealing with the Mid-Atlantic area; a paper by Terry Fox that appeared in the 5th Computer Networking Conference is enclosed to give you the flavor.

The Ad Hoc Committee on Amateur Radio Digital Communication plans to make recommendations on packet-radio frequencies and will provide you with input most likely after its June 14-16 meeting.

73,

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communication

cc: Director Stafford

PLR/cs

THE AMERICAN RADIO RELAY LEAGUE, INC.
INTERNATIONAL SECRETARIAT OF THE INTERNATIONAL AMATEUR RADIO UNION
ADMINISTRATIVE HEADQUARTERS NEWINGTON, CONNECTICUT, U.S.A. 06111

RODNEY J. STAFFORD, KB6ZV
PACIFIC DIVISION DIRECTOR
5155 Shadow Estates
San Jose, CA 95135

April 6, 1986

Lys J. Carey, K0PGM
ARRL Director, Rocky Mtn Division
13495 West Center Drive
Lakewood. CO 80228

Re: Minute 45 (h) of the Jan. 1986 Board Meeting

Dear Lys,

Regarding recommended packet frequencies in the VHF and the UHF spectrum, I can't imagine a more orderly and logical argument for the planning set out in the March, 1986 issue of QEX. So that you won't have to go digging for the article, I have enclosed a photocopy of it for you. NI8E has covered VHF and UHF packet requirements well in the article. I would recommend the MSC propose that the ARRL adopt the frequency plans set out in the article as "recommended frequencies" for packet usage in VHF/UHF. I'll be interested to see if the VUAC and the AD Hoc Committee come up with similar suggestions.

Any recommendations for frequencies for HF operation of packet is a bit more complex, especially in view of the Executive Committee's directive to Chris Imlay to seek STAs for the League to set up packet systems on HF to determine interference potential (see minutes of 3-22-86 EC meeting). At this point, we may not even want to recommend HF frequencies. On the other hand, if we make a recommendation, we may have some influence on the orderly development of HF packet on a "non interfering" basis. As it stands right now, HF packet on 20 meters interferes with some of the beacons that operate on 14.100 Mhz.

As published in QST each January in the "Considerate Operators Guide," we list recommended frequencies for RTTY and SSTV. Why not list some recommended frequencies for packet?

By the way, I will be sending along some thoughts later on Minute 69, my proposal about the tape-recorded news service. I really think that it is a workable idea, notwithstanding Steve Mendlesohn's comments about costing $20,000. for a tape recorder.

Good luck in your endeavors with the MSC. I think that's a very important committee. That seems to be borne out in the fact that several of the matters at the January meeting were referred to the MSC.

Sincerely,

Rod

Rod Stafford

cc: N6TX, VUAC
W4RI, AHDCC

The Michigan Packet Radio Frequency Plan

By James E. Brooker, NI8E
696 Graefield Court,
Birmingham, MI 48008

The date was November 17, 1985, the place was Albion College, MI, and the attendees included representatives of Packet Radio in Southern Michigan (PRISM), the Packet Technical Group (PTG), State RACES Officer James Zoss, WD8DHS, and ARES Section Emergency Coordinator George Race, WB8BGY. Packet operators from the Battle Creek, Jackson, Kalamazoo and Lansing areas were also present. Why the gathering? To discuss a frequency plan for Michigan packet radio operation. This plan was unanimously agreed on at a state wide Packet Radio Frequency Planning Conference held at the college. Details of the agreement were compiled for this article.

At the same meeting it was also agreed that PRISM would act as the packet-frequency-coordination organization as needed. It would operate under the umbrella of the Michigan Area Repeater Council and with the cooperation of other packet-related amateur groups in the state. The plan may require amendment at a future date to more accurately reflect the rapid growth of packet, new protocol or higher speed operation.

The policy of the Michigan Repeater Council does not allow for coordination of packet channels on 144 to 148 MHz. These are simplex channels that can be used by amateurs in any mode and location. All activity in this range will have to be by "gentleman's agreement," much as it already is. Anyone is free to put up a digipeater or BBS, as long as it is understood that anyone else can do the same no matter what their location. What sort of packet activity will take place on a particular channel is left to the conventions of usage, not coordination by the council.

144 MHz "Gentleman's Agreement"

144.91 Experimental and QRP
144.93 Local Area Network
144.95 Local Area Network
144.97 Local Area Network
144.99 Non digipeated Packet Simplex
145.01 Inter-LAN and Mail Forwarding
145.03 Local Area Network
145.05 Local Area Network
145.07 Local Area Network
145.09 Local Area Network

LAN frequencies would be activated in the following order:

1. 145.03
2. 145.05
3. 145.07
4. 144.97
5. 144.95
6. 144.93

The lowest numbered available frequency would be used unless it is already activated in a geographic area. It is not our intention to replace the existing backbone network on 145.01 MHz with these frequencies. These additional frequencies would supplement the network, providing room for growth as traffic and BBS activity increase.

The objective is to avoid conflict with existing voice operations on the above frequencies. It is important that packet expand in a contiguous group of frequencies and not all over the 2-meter band. This will help "carve out" a segment of 2 meters which ultimately will become recognized as a "packet subband."

220 and 440 MHz

In this coordination plan, 220-MHz channels that function in the same way as 144.91- to 145.09-MHz channels are called "uncoordinated (test)" channels. They are analogous to "test pairs" that some repeater councils set to give repeater trustees a chance to test a site or equipment before they know what type of coordination to request. Each party using such a channel knows that they can establish a repeater on the channel without coordination, but that others are also free to do so after the system is on the air.

It is important to provide room on the 220- to 225-MHz band for both 1200-baud and 9600-baud packet for two reasons. First, meaningful public-service communication cannot occur on 2 meters while stations in a Red Cross building or in an Emergency Operations Center (EOC) are simultaneously engaged in voice nets through 2-meter systems (that is virtually where all emergency voice nets are held). The packet and voice transceivers will desense each other. Using 220 for packet allows general emergency nets on 144 MHz and voice coordination of packet and logistical traffic on 440-MHz repeaters and frequencies. Also, there is room for dual-frequency digital repeaters on 220 MHz that promise to offer inherently higher rates of throughput and far fewer collisions and retries.

Second, if the FCC grants the ARRL proposal for new Novice class privileges, a potentially large number of new, inexperienced amateurs will be seeking to operate unsophisticated packet stations on 220. This large number will result in an unprecedented demand for frequency spectrum in which to use 1200-baud packet, where the stations will need to rely on wide-area digipeaters for range, since their owners will not be as skilled in antenna or equipment utilization as the more advanced amateurs now on packet. Also, with enough channels for 1200-baud work, both public service and more general packet communication can coexist on the same 220-MHz band without the traffic from one kind of activity causing problems for the other.

Single-channel store and forward digipeaters are the core of most LANs and actually serve as the network between LANs, but this may not be true in the future. Passive two-channel digital repeaters provide double the throughput rate with far fewer collisions and resulting retries. Such systems cannot be implemented on 144 MHz (or virtually not on 440 MHz) in eastern Michigan since all potential coordinations have already been made. This is not the case on 220, even in the range reserved for nonvoice activity (220.5 to 222.34 MHz). Although there is room to coordinate two-channel digital repeaters in the voice range, this is not true in Illinois, New York or California. Michigan and Ohio are lagging these states in 220 voice activity, but only by a number of years. Assigning these channels might work in the eastern half of Michigan and over most of Ohio now, but Indiana and western Michigan would have to live with throughput slow downs from voice traffic on the input frequencies of voice repeaters in the Northern Illinois and Southern Wisconsin area.

Voice traffic is frequently heard there because of propagation across Lake Michigan. If Novices are granted 220- to 225-MHz data and voice privileges, they will naturally want to use the voice spectrum for voice traffic to the detriment of packet activity. Since their numbers are potentially very large, this could be a significant problem in the future.

The Michigan Packet Radio Band Plan is also proposed for use in surrounding states recognizing that 221.00 to 222.00 MHz is reserved by the Michigan Repeater Council for coordinated nonpacket links, and has been mostly filled already. It is particularly in demand in eastern Michigan above "line A" where 420 to 430 MHz has been deleted from amateur use and given over to land mobile concerns. A plan in Illinois to do 9600 bps linking below 221.0 and 1200 bps digipeater coordination above 221.00 to 222.00 conflicts with coordinations long granted in Michigan. It is probable that no one in Illinois contemplating packet activity on 220 to 222 MHz is aware of this conflict. Communication should be established with those believed to be handling coordination there to resolve the problem before crystals and other equipment are ordered. Communications in this area is important since there is a strong likelihood that 420 to 430 MHz will be lost throughout the country in the near future, and demand for a nonpacket linking area on 220 will grow.

1200-baud two-channel
repeater outputs

(1200 bps simplex in the absence of a digital repeater in a particular area):

Output/Input
220.52 MHz/222.12 MHz
220.54 MHz/222.14 MHz
220.56 MHz/222.16 MHz
220.58 MHz/222.18 MHz
220.60 MHz/222.20 MHz
220.62 MHz/222.22 MHz
220.64 MHz/222.24 MHz
220.66 MHz/222.26 MHz
220.68 MHz/222.28 MHz
220.70 MHz/222.30 MHz
220.72 MHz/222.32 MHz

This is an inversion of the offset for 220 voice repeaters and is chosen for two reasons. By making the Michigan coordinations on these potentially overlapping channel inputs, it is possible to minimize packet traffic on those voice channels in the event there have been any voice repeater input coordinations in nearby states between 222 to 222.34 MHz (with outputs 1.6 MHz away) contrary to the ARRL band plan. More importantly, this allows two-channel digital repeaters to be collocated with standard voice repeaters operating at the high end of the band, since outputs are as far apart as possible and inputs do not need mutual protection. Obviously, if preferred, the input and output channels can be switched with no effect on the rest of the band plan.

Simplex 1200-bps channels, solely for coordinated single-channel, store and forward digipeaters and station-to-station packet simplex work, such as long file transfers:

220.74 MHz
220.76 MHz
220.78 MHz

Four 9600 bps uncoordinated (test) channels for packet linking:

220.825 MHz
220.875 MHz
220.925 MHz
220.975 MHz

If Novice activity on 220 to 225 MHz with 1200 bps outstrips the capacity of ten dual channels and three single frequency channels at some future date, the above four 50-kHz channels might be withdrawn for reassignment as ten coordinated 20-kHz single-channel, store and forward digipeater and packet simplex channels to handle the increased demand for 1200 bps spectrum on this band. This segment would then be assigned as:

220.80 MHz
220.82 MHz
220.84 MHz
220.86 MHz
220.88 MHz
220.90 MHz
220.92 MHz
220.94 MHz
220.96 MHz
220.98 MHz

Two 9600 bps uncoordinated (test) channels for packet linking:

222.025 MHz
222.075 MHz

Voice activity on the 125-cm band would continue to be coordinated consistent with the ARRL band plan:

222.34/223.94 MHz
(WA8MGO, Battle Creek)
222.36/223.96 MHz
—
—
—
223.34/224.94 MHz (Plymouth)
223.38/224.98 MHz (Cleveland)

Nineteen coordinated 50-kHz packet linking channels (430 to 431 MHz):

430.025 MHz	430.525 MHz
430.075 MHz	430.575 MHz
430.125 MHz	430.625 MHz
430.175 MHz	430.675 MHz
430.225 MHz	430.725 MHz
430.275 MHz	430.775 MHz
430.325 MHz	430.825 MHz
430.375 MHz	430.875 MHz
430.425 MHz	430.925 MHz
430.475 MHz	(Already coordinated link)

As W4WWQ suggests in the October 16, 1985 issue of *Gateway*, the ARRL packet newsletter, he "...would like to encourage some thought into use of the 420- to 450-MHz band instead of the 220-MHz band for 9600-bps linking." In some parts of the country, good, inexpensive, surplus commercial RF equipment for the 450-MHz band is available. "It seems a mistake to overlook the older equipment that has been the cornerstone of public safety communications for years." Much of that equipment is easily "broadbandable," if for no other reason that much of it was originally wideband FM gear. "Inexpensive" is an understatement, because much of it (even in solid-state form) can be had for the asking at hamfests. Tighter beamwidths and higher antenna gain for similar physical size antennas at 430 MHz rather than 220 MHz also would make it easier to coordinate links in such a way that mutual interference would be minimal.

The TAPR networking node controllerTNC will have four ports to allow most digipeaters to link in different compass directions or to a BBS. Each port would have to be outfitted with over $350 worth of 220-MHz boards, crystals, boxes and amplifier to deliver about 10 watts output per link. Multiply this times four, and each digipeater would require a $1400 expense to link in each compass direction, or $700 in a straight line, excluding antenna or feed-line costs. Many older UHF transceivers can generate 10 watts and are available for $15 to $35, allowing (after conversion costs) for linking in the four directions for under $200, again excluding antenna or feed line costs. FADCA beta testers of the K9NG modem and other manufactured boards who have shared their reactions on CompuServe, have been less than enthusiastic about the feasibility of manufactured boards for this kind of service.

[Comments or questions concerning this plan should be directed to Jim Brooker, NI8E. He is chairman of the PRISM Spectrum Planning Committee.—Ed.]

THE AMERICAN RADIO RELAY LEAGUE, INC.

INTERNATIONAL SECRETARIAT OF THE INTERNATIONAL AMATEUR RADIO UNION

ADMINISTRATIVE HEADQUARTERS NEWINGTON, CONNECTICUT, U.S.A. 06111

April 29, 1986

Harold Price, NK6K
1211 Ford Ave
Redondo Beach, CA 90278

Dear Harold:

At Dayton, you asked why Chris Imlay was directed to file a Partial Opposition to Petitions for Reconsideration under PR Docket No. 85-105, a copy of which is enclosed. Sorry for drawing a blank on it; I can only plead jet lag.

The whole idea was to isolate the below-30-MHz question so that the FCC could go ahead and reconsider what was germane to the proceeding -- above 30 MHz.

Although the ARRL Board of Directors has not taken a position favoring automatic operation for digital communications below 30 MHz, I think you can appreciate that the Executive Committee's recent agreement to seek an STA shows a willingness to at least tippie toe down that path with eyes and ears open.

Possibly you would have called it differently, but Dave Sumner is confident that this was our best shot within the realm of the possible.

73,

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communication

PLR/cs

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 97 of the Commission's Rules to Permit Automatic Control of Amateur Radio Stations	))))	PR Docket No. 85-105

To: The Commission

PARTIAL OPPOSITION TO PETITIONS FOR RECONSIDERATION

The American Radio Relay League, Incorporated (the "League") hereby respectfully submits, pursuant to §1.429(f) of the Commission's rules, its Partial Opposition to certain of the nineteen Petitions for Reconsideration filed in this proceeding, relative to the suggestions contained therein that automatically controlled digital operation be immediately permitted on amateur frequencies below 30 MHz. In partial opposition to such arguments, the League states as follows:

1. The Report and Order in this proceeding, FCC 86-18, 51 Fed. Reg. 3069, released January 16, 1986, stated, in part, as follows:

> 6. Some commenters suggest that MF and HF frequencies between 1.8 and 29.5 MHz be added to the frequencies available for automatic control or that automatic control be extended at least to all digital communications below 29.5 MHz on a regular basis or by temporary special authority (STA). They state that coast-to-coast coverage for point-to-point message handling would be accommodated by including MF and HF frequencies.

> Because of the possibility of congestion on the MF and HF frequencies, we do not believe that it would be advisable to permit automatic control on those frequencies.

The League's Petition for Rule Making, on which the Commission's <u>Notice of Proposed Rule Making</u> in this proceeding was based, recommended that automatic control of digital communications be permitted above 30 MHz only.

2. Yet, the reconsideration petitions of John T. Smith (KI4XO), Walter E. Miller (AJ6T), Eric C. Williams (WD6CMU), William F. Dickson, II (N6BAH) and Donald Simon (NI6A) each suggested that automatic control of amateur digital operation be permitted on MF and HF frequencies as well as above 30 MHz. The arguments made in those Petitions in favor of permitting automatic control of digital communications below 30 MHz are that packet stations are highly organized and orderly in terms of channel selection; that digital, and specifically packet, communications are highly spectrum efficient vis-a-vis CW, SSB, or standard RTTY operation, and are channelized around a few specific frequencies; and that amateurs have always cooperated in spectrum use and will continue to do so with the addition of automatically controlled HF packet communications.

3. The League is not necessarily opposed to automatic control of digital HF communications, but believes that authorization of the same while operating standards are still evolving would be premature. As such, it is opposed to blanket authorization for automatic control of digital communications on HF frequencies. A number of questions are at present unanswered

concerning such operation, which cannot be answered on the record in this proceeding. For example, to minimize the possibility of interference to other users of the crowded HF bands, a limited number of specific channels should be designated for the purpose. Should these be designated by rule or voluntary band plan? Should they be compatible with the regulations, band plans, and operating practices of amateurs in other countries, given the international nature of HF communication? What techniques are best in the noisy HF environment to ensure that a station operating under automatic control will not cause harmful interference to other stations? As efficient packet-radio operation depends on time-sharing of a channel for multiple simultaneous communications, would greater speeds than the 300-baud rate now authorized below 28 MHz permit greater efficiency? Should automatic control of digital techniques other than packet be permitted? Unanswered questions such as these are basic to interference avoidance and to maximizing the benefit of such operation to the Amateur Radio Service generally. Thus, it is necessary for the League to oppose the suggestion in the various reconsideration petitions that automatic control be permitted for HF digital communications in this proceeding at this time. The Commission quite properly did not authorize (but also properly did not substantively decide against) HF automatic control in the Report and Order.

4. That having been said, the League also notes that there is an unfilled need in the packet radio community to permit the automatic forwarding of messages across paths not presently spanned by VHF/UHF stations. While ultimately it would be preferable for all paths to be covered on VHF or UHF, by either terrestrial or satellite means, the development of such a complete network will take a number of years. It is essential in the meantime to link the regional packet networks that have developed in various parts of the country.

5. To facilitate the development of packet networks, while at the same time providing a means to develop technical answers to questions such as those listed above, the League plans to coordinate a <u>small</u> group of licensees seeking special temporary authority to operate packet stations under automatic control on specified spot frequencies (one frequency per band) at various locations around the country. Experience gained by such operation would permit the amateur community to determine which kinds of HF automatic control operations should be permitted, if any, and which should not. It is suggested that the few STAs to be sought by those amateur stations coordinated by the League (and only those) should be granted for a sufficient period, probably one year, to permit a determination of both the feasability of automatic control below 30 MHz, and the rules necessary to govern the same, in order to prevent interference to and from other amateur stations.

6. On another subject, a number of the reconsideration petitions, notably those of Richard K. Whipkey (AD6X), Warren Struven (W6CB) and Donald Simon (NI6A), suggested that the Report and Order in this proceeding should "not be implemented" pending "a greater in-depth study of amateur radio packet switching networking." It is the League's understanding that in making these arguments, the petitioners are not suggesting that the portion of the Report and Order which generally authorized automatic control of digital communications above 30 MHz be withdrawn or not implemented. Rather, their concern is with the portion of the Report and Order which precludes automatic control of any station while transmitting third-party traffic. While all petitioners, including the League, argued that the control operator requirements in the Report and Order would cripple the development of amateur digital communications, the authorization of automatic control generally for amateur digital communications above 30 MHz is most important to such development. Those reconsideration petitions recognize that fact. Hence, the reconsideration petitions of these individuals should not be misconstrued. The affirmative portions of the Report and Order should be implemented.

THEREFORE, for the reasons stated above, the American Radio Relay League, Incorporated respectfully suggests that the Commission not generally authorize automatic control of digital communications on amateur frequencies below 29.5 MHz at this time, but rather address the matter by the method recommended by the

League herein by granting the several STAs to be sought in the near future under League coordination; and further, that the Commission proceed with that portion of the Report and Order which generally authorizes automatic control of digital communications above 30 MHz.

Respectfully submitted,

THE AMERICAN RADIO RELAY LEAGUE, INCORPORATED

225 Main Street
Newington, CT 06111

By: Christopher D. Imlay
Christopher D. Imlay,
Its Counsel

Booth, Freret & Imlay
1920 N Street, N.W., Suite 520
Washington, D.C. 20036
(202) 296-9100

March 26, 1986

<u>CERTIFICATE OF SERVICE</u>

I, Francine J. McCullion, Office Manager of the law firm of Booth, Freret & Imlay, do hereby certify on this 26th day of March, 1986, that I have caused a copy of the foregoing **PARTIAL OPPOSITION TO PETITIONS FOR RECONSIDERATION** to be mailed, via first class U.S. mail, postage prepaid, to the offices of the following:

Robert T. Martin, N6MZV
10382 Orange Avenue
Cupertino, CA 95014

S.E. Carlson, KA6ERF
560 Greenbach Street
Napa, CA 94558

Karl Fraser, KK1A
P. O. Box 741
San Francisco, CA 94101

Robert F. Franklin, K6TP
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Francine J. McCullion

Francine J. McCullion

March 26, 1986

25-B Hillcrest Rd
Warren, NJ 07060
April 8, 1986

Tony Dawes G6VZF
2445 Cajun Drive
Marietta GA 30066

Dear Tony,

I received and read with interest your paper on Packet Radio Networking that was distributed to the ARRL Digital Committee. Since you describe it as a "discussion document," here are some personal opinions. I'm sure that certain other members of the committee will disagree with me, so I'm sending a copy of this letter to the other members so they can have their say.

The major observation I have is that you seem to assume that because X.25 is a CCITT standard, then, a priori, it must be a good starting point for amateur packet radio. I believe that our experience so far is compelling evidence to the contrary, and that the DoD/ARPA protocol suite would be much closer to our needs. To elaborate:

1. X.25 was designed as an interface between a user and a public data network, using point-to-point links. It is not well adapted to, nor does it exploit the unique capabilities of, a multiple access broadcast media such as radio. It says nothing about how a packet network should be built internally. In comparison, the DoD protocols have accumulated considerable practical, operational experience on a wide variety of media, including several satellite and terrestrial packet radio networks with mobile users.

2. The notion of a "connection" (i.e., "virtual circuit") permeates X.25 and unfortunately, AX.25. While many applications do require connection-oriented service, many others find it very clumsy, preferring instead a simple "connectionless" or "datagram" type of service. (Examples include routing algorithms, database query/response systems and real-time applications such as packet voice, where occasional lost packets are acceptable but timeout/ retry algorithms at the link layer are not).

   The ideal network architecture would make both connection-oriented and connectionless services readily available to the users. Even when an application uses an end-to-end connection, it is not at all obvious that the network nodes ought to be aware of its existence. (They are already busy enough just switching packets and keeping track of a changing network topology). There is much to be said for an architecture such as the DoD suite that builds virtual circuits (when needed) at the transport layer atop a purely connectionless network service. Only then can the network nodes take advantage of many elegant mechanisms that are possible only with datagrams atop a multiple access radio channel. Fortunately, AX.25 does include an "escape hatch" (the UI frame) which allows access to the underlying datagram-oriented sublayer of AX.25 without having to use the connection-oriented LAPB sublayer. (More about this later).

3. For all its complexity, X.25 only covers ISO layers 1-3. When you put a full-blown transport protocol on top of it, especially when you're trying to "internetwork" X.25 with other types of networks, you discover that much of X.25 is superfluous. Much of what it tries to do can only be done properly on a true end-to-end basis by the transport layer (e.g., guarantee end-to-end data integrity). While link level acknowledgements can probably be justified in packet radio as a performance enhancement, there are much simpler ways to provide them than by carrying along all the baggage in X.25.

4. The additions made to X.25 Level 2 to form "AX.25 Level 2" resulted in a far-reaching change in the protocol's character. It is really a multi-layer protocol that is being used to

cover (albeit poorly) Levels 3 and 4 of the ISO Reference Model. The call signs in each packet header comprise a de-facto datagram-oriented network layer header, and digipeaters can be seen as datagram-oriented packet switches (albeit rather crude ones). The LAPB portion of AX.25 can then be seen as a connection-oriented end-to-end transport protocol. It sets up and tears down connections, handles flow control, and recovers from lost packets, all functions normally the province of end-to-end transport protocols. "AX.25 Level 2" is much closer to the spirit of ARPA TCP/IP than its designers will ever admit, although in comparison, AX.25 is very limited in what it can do.

What follow are some specific comments on parts of your paper.

Page 6 (figure 1). What happened to the Transport layer? In my opinion, the transport layer is an essential element in any packet network, because no matter how hard it tries, the network can never absolutely assure reliability. Also, I believe it would be better to insert "parking garages" between the end users to represent the network nodes, emphasizing more clearly that link and physical "connections" are not end-to-end, but rather node-to-node.

The ARPA suite has no need for a distinct Session layer. The relatively few functions it would provide were included in the transport layer.

Page 13 (Station location). I think you're confusing the distinction between addressing and routing. Routing based solely on latitude/longitude coordinates is insufficient, because the optimal next hop to take may not be the one that's geographically "toward" the destination (consider, for example, a satellite "wormhole" between the East Coast and the West Coast of the USA. The best route from a station in Las Vegas to New York may very well be through a satellite gateway in Los Angeles). It is certainly alright to make whatever addressing scheme is chosen have some relevance to the network topology for the reasons you state (avoiding large routing tables), but in the real world you cannot avoid having SOME lookup tables.

Page 17 (connection establishment) Why can't a user simply identify just the end station he's interested in communicating with, instead of having to first establish an explicit connection with some local "network node"? I've often been bothered by the rather artificial distinction some people make between "user node" and "network node," usually in a sales pitch to the users that they won't have to change their hardware, software or even their operating habits very much to use all these great new services promised them by these wonderful new "network nodes." One reason digipeaters have been so popular, despite their failings, is that virtually every station can act as one at the same time it acts as an end-user station. Getting people to chip in for special hilltop or other centralized hardware they'll probably never see is always more difficult than getting somebody to buy something for his own shack. Of course there will always be cases where this is necessary, but it seems more in keeping with amateur radio psychology to encourage people to bring resources to the network at the same time they use resources provided by others. This of course means that EVERYBODY should be encouraged to have the new network protocol software in their systems. Amateur packet radio is still in its infancy, and if you think it's now too difficult to redo things the "right" way, it will only get worse. It'll take work, but there's no free lunch here -- only "credit plans" with very high interest rates.

As an alternative to the CCITT X.25 "model" I would like to suggest that you consider the set of protocols adopted by the US Department of Defense Advanced Research Projects Agency (DoD/ARPA), including IP, TCP and UDP. IP provides a connectionless (datagram) internetwork level service that is specifically designed to be easily placed atop existing subnetwork protocols (such as AX.25 Level 2). Applications desiring a virtual circuit service use the transport protocol TCP, while those preferring a datagram service use UDP. I have implemented these protocols (plus a few applications) in C and have them running on the Xerox 820, among other machines. You are most welcome to my source should you wish to experiment with it on the air. Just send a blank 8" SSSD CP/M or a 5.25" DSDD MS-DOS floppy with return SASE.

If you are bothered by the notion of using an "American" protocol, particularly one associated with the military, I would like to point out that there is considerable activity within ISO and other areas (e.g., GM's MAP project) to define protocols that are architecturally and functionally very similar to (although, unfortunately, deliberately incompatible with) TCP/IP. Unfortunately the international standards process is very slow and painful, with plenty of typically bureaucratic moves such as making a whole set of mutually incompatible transport protocols "co-standard" to avoid having to make any politically unpopular choices. If ISO's effort is to survive, there will almost certainly have to be an eventual shakeout of the zillions of current options, and I am confident that those remaining will be the ones that look most like TCP/IP -- for which the specs and implementations have been stable for the past 3 or more years. So even if ISO is the way to go in the long run, experience now with TCP/IP will be the best way to prepare for it. The ARPA protocols are growing so rapidly in popularity within the commercial and academic environments, though, that it's not at all clear that the ISO protocols will ever overtake them. (Remember that the metric system is 200 years old, but the US still doesn't use it -- and unlike the ISO protocols, it's not just "functionally equivalent," it's unquestionably far superior to what we now use).

Although I've been somewhat critical here, I *am* happy that you are interested enough in the "nitty gritty" of amateur packet radio to take the time to put your ideas down on paper. As you may already know, much of this stuff has always been highly controversial (both in and out of amateur radio) so the best thing to do is just to roll up your sleeves, join the discussions, and never take anything personally!

73,

Phil Karn, KA9Q